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COMPETITION IN ELECTRIC LIGHT LEADS.

THERE was quite a flutter among manufacturers when, a few days ago, one of the largest houses in the trade announced that they were about to make considerable reductions in the price of cables. This abatement was perhaps more apparent than real, and the disquietude felt by some worthy members of the industry was quite unnecessary, though, under the circumstances, not to be wondered at. When we consider what an important part in the economy of an electric lighting scheme the conductors play, when it is remembered that the first expense is a great deal higher than any other part of the system, a decrease in cost is of the utmost significance. With the price of copper and rubber fairly steady, one was naturally led to seek for the cause of this reduction. A close comparison between the new and old lists issued by the house mentioned reveals the fact that in the larger class of cables there is a considerable diminution in the quantity of insulation. How far this retrenchment in the dielectric is justified we cannot pretend to say, but it remains a clearly established fact that manufacturers have hitherto gone to needless excess in dielectrics for ordinary purposes. They have used insulating material in the most lavish manner, over and above what was required to meet mechanical stress. It may sound well to have a cable with an insulation of extraordinarily high specific resistance; but do the users of electric light cables absolutely understand this term? It is perfectly easy with a high specific insulation resistance, such as is obtained in the best qualities of rubber, to get the necessary number of megohms when using a very small quantity of this high quality; thus it will be seen that what is required is not only megohms, but megohms combined with a sufficient mechanical protection to retain them at their original quantity. As a matter of fact, megohms ought to be regarded as simply stating the quality of the dielectric, based upon the assumption that at the highest number one has the purest material, and which, by reason of its not being adulterated, will stand the greatest strain under the ordinary wear and tear of climatic conditions.

The announcement of a decrease in rates is very much like throwing down the gage of competition; what effect it will have on cable makers as a body it is difficult to say. We are inclined to think that they will follow the example set, and that the reduction will become general. Some may consider themselves above competition, and unaffected by what others do; that may be so, but if they want to sell cables in an open market it will be necessary for them to have regard to the universal price. The firm which has notified this abatement will no doubt secure a temporary trade advantage over the makers who were unprepared for the reduction. Reduced prices always appeal to the contractor, and he will naturally buy in the cheapest market; but there will be a

speedy adjustment on all sides, and the "balance of power" eventually will remain undisturbed. Manufacturers will be mostly affected through their stocks, and in disposing of these at current prices they may have to put up with considerable loss.

A maker who contemplated serious reductions would no doubt quietly dispose of old stocks, and after keeping his machines employed for some time in making the cheaper goods, would be well fitted to enter into a battle of prices. While we gladly recognise these attempts to bring down the cost of the most expensive part of an electric lighting system, and while it must be admitted that the reduced prices will be beneficial rather than otherwise, we should regret to find manufacturers entering into a throat-cutting competition. Though "corners" of any kind are objectionable, we would sooner see them make an arrangement for obtaining a fair price for a good article. A long period of rivalry may have the effect of cutting down prices still further, and as soon as that commences inferior work will result. Some of the larger firms by virtue of special circumstances might be able to weather a course of disastrous competition, but such a pass, we hope, will not be reached. A limited liability company with a large number of branches of manufacture might run its cable department at a dead loss for a considerable time, and the trading accounts would fail to show it. In fact, outside the managing director, nothing whatever need be known. We sincerely hope that it will never be necessary for any manufacturers to adopt this policy.

The Death by Electricity at Blackfriars.

WE are getting at some of the facts connected with this case, but, as it is still *sub judice*, we cannot now comment upon them; we, would, however, like to know whether the insulation resistance of the rubber gloves and boots worn by men engaged at high pressure works is ever measured. Rubber gloves and boots are subject to wear and tear, so that however good the insulation may be when new, this rapidly deteriorates, and only by regular testing for insulation can faulty gloves and boots be discovered. But is this testing ever attempted? Is it not possible to box in all high pressure bars, switches and fuses, so that the opening of the box for such a trifling excuse as for the purpose of dusting would cut off the current and render it impossible for it to be turned on while the box was open? If such a device is considered necessary at Deptford to keep workmen from the high pressure at the dynamos, is it not quite as necessary at sub-stations. Manufacturers are compelled to securely fence in all belts, wheels, and other machinery, under heavy penalties; is a high pressure terminal, bar or switch, not a piece of machinery under the Factory Acts? Is there no simple signal which can be devised to indicate to the most ignorant workman when a bar or terminal or switch is charged and so warn him off? These and similar questions occur to one every time an accident happens to workmen at high tension stations; so, perhaps, some of our electrical engineers will express their views, in our columns, on these very important questions. On the matter of insulating boots we have heard that gutta-percha moulded boots, with no irons in them, as made by R. and J. Dick, are more reliable than rubber boots. The late Robert Dick, who was a noted gutta-percha merchant and also an enthusiastic amateur electrician, personally investigated this subject, and also engaged electricians to do the same, the general conclusion being that rubber, when worn constantly, rapidly lost its insulating properties, except in some cases where pure rubber moulded boots were made, whereas, gutta-percha maintained its insulating properties for a longer period.

Cardiff Lighting.

COMPLAINT has reached us from one or two quarters of the way in which cable manufacturers have been treated, by the Corporation not having advertised for tenders for the town lighting in the usual way, viz., in the leading electrical papers; also that only seven days were allowed for getting out the necessary specifications (which all parties contracting were required to do for their own manufactures) and prices. On looking into the matter we find that an advertisement appeared in *Engineering* on October 6th, drafted on the usual lines, and tenders were to be delivered in Cardiff on the 16th inst., thus only eight clear days were allowed to the contractors; this is short enough time in any case. Their chief point of complaint, however, is that Cardiff's Town Clerk ignores the fact that most electrical engineers look for information on purely electrical matters in their own technical journals. For our own part we must say we think contractors in this case have been very hardly treated, or that perhaps one, more fortunate has been unduly favoured. *Verb sap.*

The Measurement of Alternating Currents.

WITH the present issue we complete the report of Dr. Fleming's Cantor lectures on "The Practical Measurement of Alternating Currents." Those of our readers who were fortunate enough to hear the delivery of these lectures will be glad to have a record of them, and those who did not should make a study of them at once or they will be far behind the run of things. Our report was rewritten from the *Journal of the Society of Arts*, together with some revisions; that any alterations were necessary arises simply from the unfortunate circumstance that no report can adequately fill the gaps where actual experiments were to be observed. As a contribution to "commercial" science these lectures must hold a high place; they are something more, however, than mere practical hints to practical men, they include theoretical questions of the greatest significance, yet stated so clearly that their complications are disguised and their difficulties vanish. Alternating currents are very serious playthings, for they have this peculiarity about them, that if, in ignorance of their laws you fall out with them, it is not the *word* first and then the *blow*, but the *blow* at once without the *word*. There is every reason then for would-be experimenters to begin, without delay, the study of those laws, and for this purpose we commend to them the lectures of Dr. Fleming.

Field Magnet Windings.

IN getting at the size of wire required to produce the necessary magnetomotive force in an electro-magnet, there is often a considerable waste of time in proceeding by trial and error. In our contemporary, *L'Industrie Electrique*, will be found a short article by M. Bary, which gives simple formulæ enabling one to get a very close approximation at the first trial. Of course, the method merely gives the diameter of the wire required to suit the conditions of the winding, and as this will probably not be a commercial gauge, two or three trials are still required before one can get at the required result.

Soft Iron Instruments.

IT is well known that ammeters and voltmeters, constructed with soft iron parts, are liable to a more or less considerable error, due to hysteresis, but it has not been pointed out which of the types is best as regards smallness of this error. M. Meylan has been experimenting in this direction, and arrives at the conclusion that, at any rate for direct currents, the best form is that in which the solenoid sucks in a small piece of soft iron parallel to its iron axis.

THE PRACTICAL MEASUREMENT OF ALTERNATING CURRENTS.

Lecture IV.

The fourth and last of the series of Cantor lectures by Dr. Fleming was given to the discussion of alternating current "energy," and alternating current "quantity." Proceeding in the same order as when considering "power," the lecturer first approached the easier problem of the energy supplied to non-inductive circuits, and then examined the more complex case of inductive systems, such as the primary circuits connected with alternating current stations.

Instruments for the measurement of alternating current energy, or quantity, were called simply "meters," classified into "ampère-hour meters," and "watt-hour meters." In their simplest form they could be called "graphic ammeters" and "wattmeters." The Holden ammeter and the Mengarini wattmeter were examples. In these instruments an arm, carrying a pen, is placed over a paper-covered drum, which is revolved uniformly in 24 hours by a clock. The motion by which the pen is displaced is regulated by a part of the instrument which is simply an ammeter or a wattmeter; the extent of movement of the pen is, at any instant, proportional to the current or the power passing through the measuring part at that time. When, therefore, the diagram is cut off and unrolled, there is found on the paper a curve, which represents by its ordinates the power at any instant; and if the whole area of the curve is integrated, then such area represents the total energy or "quantity," which has passed through the meter in 24 hours. These instruments have, therefore, the practical advantage of recording two functions at once; they serve the double purpose of indicating the instantaneous current or power, and the total current, quantity or energy. They have, however, the disadvantage that they are not self-integrating.

Next in order of simplicity are the self-integrating ammeters and self-integrating wattmeters. Of the ammeters of this class, one of the simplest is the well known Shallenberger instrument. This is, however, available only for the measurement of alternating current quantity. The Shallenberger meter consists of a small transformer, one coil of which may be called the primary, this is in series with the circuit in which the current to be measured is flowing. The core of the transformer consists of a little soft iron disc, which is capable of revolving on an axis. This axis is geared at the top with a counting mechanism, which records the number of revolutions of the disc; at the bottom there is a vane or fan of aluminium, which serves to retard the rotation of the disc. The secondary circuit of this transformer consists of a small coil of copper which is closed upon itself, and which is placed with its axis inclined at 45° to the axis of the primary coil. When the primary current flows through the primary coil it does two things: it magnetises the core, and it induces a secondary current in the closed secondary circuit. It is not difficult to show that the phase of this secondary current must be about 90° behind the phase of the primary current, also that the magnetism of the iron core, which is in a direction at right angles to the plane of the primary coils, also lags in phase behind the primary current by about 90°. The magnetism of the core and the induced secondary are, therefore, in step, and are in such directions that the axis of the disc is always being pulled round by the induced field of the secondary coil. If, then, there were no friction of any kind, the iron disc would be continually accelerated in speed; but, since the air friction varies approximately as the square of the velocity, and since the mean driving force is proportional to the mean square of the current strength, it follows that the total number of revolutions which the disc makes in any time is proportional to the total mean quantity or ampère hours, which have passed the primary circuit. The meters can, therefore, be calibrated for a constant in such a way that they read directly ampère hours, and if the pressure between the mains is invariable, they may be graduated to read in Board of Trade units. These meters are very simple to construct and very fairly accurate in performance; they have, therefore, come into extensive use. The velocity of the disc being, at any time, proportional to the mean current passing through the meter, it is possible, if the current is kept tolerably constant, to employ the instrument as an ammeter. By moving the position of the secondary coil, a little adjustment can be made in the meter for change of frequency; so that the instrument can be calibrated for the particular frequency for which it is intended to be used. The 10-ampère-meter starts with less than half an ampère and reads up to 10 ampères. The greatest variation in accuracy, within this limit of reading, is about 3 per cent. The meter has therefore a range of about 1 to 25, and, with care in adjustment, can be made to read more accurately than the above-mentioned figure.

The next in order of simplicity, and very similar in principle to the Shallenberger instrument, is the Wright-Ferranti meter. This is also a self-integrating ammeter; it measures, at any instant, the mean square current, and gives the mean quantity which is passed through the meter. The indicating part consists of a wheel with a light iron rim, which is nearly embraced by two curved horns of laminated iron. These horns spring from the corners of a rectangle of laminated iron, which is wound over, on all four sides, with two coils of wire. Through one of these coils the current to be measured passes; the other coil is a shunt coil, the function of which will be described below. The arrangements of the coil are such that at any moment the ends of the curved horns are oppositely magnetic poles. Copper rings are placed upon these curved horns. When the alternating current passes through the series coil it creates alternating magnetism in the curved horns, but owing to the eddy currents set up in the embracing rings, the magnetic lines of force are thrust outwards, making a lateral leakage field, which travels up the horn. This leakage field induces eddy currents in the iron disc which is thereby repelled, in virtue of the electro-magnetic repulsion between the horn and the wheel. To illustrate this repulsion, Dr. Fleming exhibited a large alternating current magnet, across the top of which he placed a laminated iron bar, embraced at intervals with copper rings. Near to the iron bar he held a soft iron disc, mounted on a pivot, which began to revolve rapidly, as soon as the alternating current was set in action. This could be explained by saying that there were a series of alternating magnetic poles, running up the iron bar, and that these alternating poles induced other poles in the iron of the disc, which was thus pulled round.

In the Wright-Ferranti meter, the axis which carries the wheel has upon it four aluminium or mica vanes, and was also in connection, at the top, with a counting mechanism. When an alternating current is passed through the meter, it tends to drive the wheel round, with a speed which is proportional to the mean square strength of the current; and, therefore, it follows that the number of revolutions made by the wheel in a given time, is proportional to the mean quantity in ampère hours which has passed through the meter at that time. A 20-ampère-meter starts with a current of about half an ampère, and reads up to 20 ampères. Within these limits, the greatest deviation in accuracy is only about 1·8 per cent. Both the Shallenberger and Wright-Ferranti meters require to be calibrated for the particular frequency for which they are to be used, and they only give Board of Trade units provided that the pressure between the supply mains is kept constant. The meter reads quantity directly, but power only on the assumption of constant pressure.

Reference was made above to the fact that there were, upon the electro-magnet, two coils, and that one of these constituted a shunt circuit. The function of this shunt is to supply the driving force which overcomes the friction of the counting train. If this circuit were not present there would be a frictional resistance to be overcome before the meter would start at all.

Another meter, of a simple character, also intended for measuring ampère-hours, is the windmill meter, invented some years ago by Prof. Forbes. In this instrument there is a coil of wire which is heated as the current passes through it, thus generating an upward current of air, which is made to rotate a very delicately constructed windmill with mica vanes. The counting train attached to the mill records the number of turns made in a given time. Although this might have seemed a somewhat unpromising principle to apply, the meter itself gave good results.

The second class of meters are the watt-hour meters, which are self-integrating. These again may be sub-divided into "continuously" and "intermittently" integrating instruments. Taking the last class first in order, it is well repre-

sented by the Frager meter, in which there is a *wattmeter part*, which measures at any instant the power and the *integrating* part, which integrates at intervals the power and the time. The wattmeter part has two coils, a thick one, which is a series coil, and a shunt coil, which is movable, being suspended by a steel wire. Attached to the movable shunt coil is a long arm, the displacement of which varies with the power passing through the instrument. Adjacent to the wattmeter, and fixed on the same base, is an electrical clock which drives a curved plate of metal, technically termed the "snail." On the end of the long projecting arm is a small steel point; as the snail is turned round, it passes underneath the arm, and, if this arm is displaced, the length of the path of the pointer when travelling over the snail, is proportional to the power passing through the wattmeter. The snail plate is pressed down as the pointer passes over it, making an engagement between the snail and the counting mechanism. At each revolution of the snail the counting mechanism moves through a number of revolutions, proportional to the mean power or watts passing; hence, the total number of revolutions in any given time is proportional to the watt-hours recorded by the meter. The period of the snail is about three minutes, and hence the record is, as it were, the summation of the power and time increments passing through the wattmeter made at intervals of three minutes. If the current which is to be measured does not vary very rapidly, such an intermittent recording meter may be made to give very accurate results, but there are many cases, as in theatres, where the amount of current is very irregularly and rapidly varied. Under these conditions, the wattmeter needle is thrown about in such a manner that the actual power recorded on the dials at every revolution is not always the true mean power passing in the interval between two revolutions, and the reading of the meter may, therefore, become very erroneous. Practice has confirmed these inferences, and although the Frager meter is, under some conditions of use, a very accurate instrument, there are other conditions under which its readings cannot be depended upon.

Coming next to the continuously recording watt-hour meters, we reach that class which may be said to be the best adapted for general wants. One of the most efficient of these continuously recording watt-hour meters is that invented by Prof. Elihu Thomson. This is a wattmeter in which the series coil carries the current, forming, really, the field-magnet of a very small electro-motor. The armature of this motor has a small commutator and brushes of the usual kind; and the armature, together with the added external resistance, constitutes the shunt circuit of the wattmeter. The shaft, which carries the armature, carries also a copper disc, which is embraced by three horse-shoe magnets. When the disc revolves, eddy currents are set up in it which retard the motion. The number of revolutions of the disc in a given time is recorded by the counting mechanism attached to the shaft. Then, since the force driving the armature round is, at any instant, proportional to the power passing through the instrument, and, since the retarding force is proportional to the velocity, it follows that the number of revolutions in a given time represents the watt-hours that have passed through the meter. In order to overcome the constant friction of the train of mechanism, there is a compound winding on the field-magnet, consisting of a few turns of the shunt coil, which is arranged in such a direction that the driving force due to the fixed and movable shunt windings, tends to overcome the permanent friction of the armature shaft. By properly treating the permanent magnets, it is found that they retain a constant field for long periods of time. The meter is so arranged that, when working on a 100-volt circuit, the shunt coil has a resistance of 1,000 ohms altogether, and takes, therefore, ·1 of an ampère. The loss in the meter, therefore, is only 10 watts, which is the power taken up in driving the motor. By properly arranging the shunt coil, it is possible to make the same constant serve for a very long range of action, and one great advantage which this meter has is that it can be employed with both alternating and continuous currents. When properly adjusted, this wattmeter is capable of very great accuracy in the measurement of alternating current energy.

The lecturer spoke of the Brillié meter as one of the same type as the Frager meter; that is to say, it is an intermittent recording wattmeter. The Mengarini recording meter, which has been extensively used in Rome, was also exhibited.

Reviewing the whole of these meters as used for alternating current measurement, the following rough classification was given:—

1. Graphic recording ammeters.
2. Graphic recording wattmeters.
3. Continuously recording ampère-hour meters.
4. Intermittent recording wattmeters.
5. Continuously recording wattmeters.

It might be asked at this stage, what ought to be the characteristics and requirements in a good commercial meter for the measurement of electric energy supply to houses, for lighting and other purposes. Most persons, without experience, would probably say that the first requirement in a meter is accuracy; but, as a practical matter, accuracy is not of so much importance as that the meter should never go far wrong. A type of meter which is capable of measuring, under some conditions, to ·1 of accuracy, and at other times is liable to make errors of 150 per cent. in actual practice, is not nearly so useful as a meter which will not read closer than 1 per cent., and yet which, in actual practice, proves never to go more than 3 per cent. wrong. The next condition with which a meter must comply is that it shall consume little power. Since a meter is connected to a circuit continually, if it absorbs power, the sum total of all these consumptions may amount to a serious item. It has been pointed out that in the case of voltmeters, a continuous power absorption of 20 watts, during the whole year, amounts to an annual consumption of 160 units of electric energy, showing that small power consumption is certainly important in appraising a meter.

The third great requisite is, that the meter ought not to require elaborate care and delicacy in fixing; it should be hardy enough to be easy of carriage. House meters have to be fixed in places which are sometimes subject to vibration, dampness, &c., and a meter for such purposes ought, therefore, to be hardy enough to stand these conditions. The fourth condition is, that the meter must be so constructed in principle as not to be capable of being easily tampered with, or its indications made to vary even when enclosed in a lock-up case. To the above requirements ought, of course, to be added, the broad and general conditions of structure and cheapness in price, as far as consistent with good workmanship.

In the distribution of alternating currents for commercial purposes, not only is it necessary to be able to measure the power or energy supplied to the consumer on the lamp circuits, but it is also required to be able to measure the power and energy sent out from the alternating current station which is supplying, generally, transformer circuits. Hence we have to consider the special difficulties of making such measurements on circuits which have a considerable self-induction, or in which the power factor of the circuits is below unity. During the past two years, Dr. Fleming had paid particular attention to this subject, in a long series of researches on the efficiency of transformers; and had thereby been led to study most of the various methods which, from time to time, have been proposed for measuring alternating current energy; passing over impracticable suggestions, he proceeded to describe the methods which had proved, in his experience, satisfactory and workable. There are two instruments for this purpose which are capable of giving such results, for the measurement of alternating current energy on inductive circuits—the Thomson recording wattmeter, and the Mengarini wattmeter. Generally speaking, these measurements have to be taken on high-tension circuits; for instance, the very common case of an alternating current station, supplying alternating current at a pressure of 2,000 volts on transformer circuits. One method of employing either of the above wattmeters for the measurement of energy would be to place a non-inductive resistance of sufficient magnitude in series with a shunt coil, and to put the series coil in circuit with one of the primary mains. In such an arrangement there would be certain disadvantages. In the first place the Thomson recording wattmeter takes a current of about one-tenth of an ampère through the shunt, and, hence, we should have to add to the shunt coil, the resistance of which is about 1,000 ohms, another 19,000 ohms of non-inductive resistance, and then, when this was done, the power wasted in the whole of these shunt circuits would be 200 watts. If they were connected to the mains

throughout the whole year, the waste of energy in these shunt circuits would be something like 1,600 Board of Trade units, and if we reckon the manufacturing cost of these at only 2d. a unit, the expense would be something like £12 per annum, merely to supply the shunt circuit with current. But this difficulty can be got over, and, also, the difficulty of constructing a large non-inductive resistance of 20,000 ohms—sufficiently well divided up not to be in any danger of breaking with 2,000 volts pressure—by the adoption of a transformer to excite the shunt circuits in the way described in the last lecture. A small transformer is employed transforming down from 2,000 to 100 volts, and, as this transformer is only to supply one-tenth of an ampère on its secondary circuit, it can be made very small, not more than, say, a tenth of a horse-power in capacity. It can, therefore, be made to waste not more than about 10 to 20 watts in itself. This transformer has its primary circuits connected across the primary mains, and its secondary circuit is connected across the terminals of the shunt circuit of the Thomson wattmeter and so joined up that the current in the shunt circuit of the wattmeter is in the same direction and has the same magnitude as if the wattmeter were joined up simply on a 100-volt circuit in the ordinary way.

The wattmeter in itself only wastes about 10 watts in its shunt circuit, and, therefore, the whole arrangement of the transformer and wattmeter can be made to waste not more than, say, 25 to 30 watts instead of 200; the reduction in the cost of up-keep is reduced to something like 200 units a year instead of 1,600. The primary current going out of the station is then taken through the series coil of the Thomson wattmeter, and, in order to keep all parts of the wattmeter at the same potential, one terminal of the secondary circuit of the little transformer is also joined up to the primary main on the side nearest to it. It is usual to mount the transformer and wattmeter on one board and then to insulate well the whole of this board. The first step is, now, to calibrate the wattmeter. This can be done most easily on a 100-volt circuit by passing through the meter known powers and observing the readings on the dial. In order to obtain what may be called "the high tension constant" of the wattmeter, the constant of the meter has then to be multiplied by the transformation ratio of the small transformer. When this is done the meter can be set up in the station in such a way that the whole current going out of the station passes through the meter, and the engineer can, by taking observations from day to day, record the whole number of units which have been taken out from the generating station on the primary circuits in any interval of time. In exactly the same way Dr. Fleming has found that it is possible to employ a Mengarini wattmeter coupled with a transformer and placed on the primary circuit. This has the advantage that it not only enables us to record the whole of the energy going out of the station in a given time, but it tells us, at any instant, the primary watts.

Before placing confidence in either of these two methods, Dr. Fleming made a very careful series of experiments and observations on an inductive alternating primary circuit, in which was employed the Thomson self-integrating wattmeter, as above described, to measure the whole number of units sent out along that primary circuit in four hours, and, at the same time, observations were made on the same circuit by means of a wattmeter to obtain the power sent out at intervals of minutes. When these observations were reduced and compared, it was found that the power sent out in four hours, as determined by the observations, was 66·924 units in the wattmeter, and the energy given by the self-integrating Thomson wattmeter in the same time was 66·946. It thus became evident that the Thomson recording wattmeter was capable of giving very accurate results as a primary wattmeter, and that there is no reason whatever why the record of the primary energy sent out should not be made in alternating current stations with the same accuracy as in the case of continuous current stations.

To complete arrangements it would be desirable in the case of an alternating current station, in order to enable the engineer to know exactly what the result of his working is, to act as follows:—On the primary should be put, in the first instance, an ammeter, capable of measuring alternating currents and giving the mean square value. In the second place, an electrostatic high tension voltmeter should be connected across the mains in order to give the high tension volts. In front of this instrument should be a Mengarini wattmeter and a Thomson self-recording wattmeter; the whole primary current from the station going through the series coils of these instruments. The shunt circuits of these instruments should be excited by a small transformer, transforming down from a working pressure to 100 or 50 volts. These instruments would then enable the engineer, by daily readings, to record, first, the energy sent out of the primary circuits in Board of Trade units in any time; secondly, the power being sent out at any instant, measured in watts; thirdly, the primary current being sent out at any instant, and the primary pressure; and from the product of these two, the apparent power being sent out at any instant; and, fourthly, from the readings of the real and apparent power, the power factor of the station could be ascertained at any instant.

By comparing these readings with the sum total of the house meters, taken at any intervals, the engineer would be enabled to know the efficiency of distribution of his alternating current station; and to reckon out, not only the cost of the unit sold, but the cost of the unit generated; and to watch and know the effect of any alterations that are made in the transformer system. It is only by adopting such methods of measurement that engineers in charge of alternating current stations will be able to remove the reproach which is sometimes hurled at them, that they have no means of measuring the energy or power they are supplying, or of knowing how much of what they make is sold.

In concluding, Dr. Fleming thanked those who had lent him instruments to enable him to show the experiments. His endeavour had been to put the subject in as practical a manner as possible; the cream of practical experience, rather than the milk of mere theory. The practical measurement of alternating currents might be more difficult, in many respects, than the measurements of continuous currents; but, at any rate, there was the satisfaction of knowing that it is now placed on a basis equally certain.

ELECTRIC LIGHTING AT BLACKPOOL.

The Old and the New.

The Corporation of Blackpool miss no reasonable excuse for bringing the merits of the town into prominent relief. Whenever occasion offers they do not hesitate to take the country into their confidence, and will heartily rejoice at any time to give the whole world and his wife a downright Lancashire welcome. Who shall blame them, for they know that the town as a bracing, health giving resort, stands almost without a rival. This, however, is not a fitting opportunity to dwell upon the recuperative properties of Blackpool breezes. We can, however, view it from another aspect, and dilate upon the real service it has done to electric lighting, and for the matter of that to electric traction also. Blackpool for years furnished the only instance in England of a system of arc lighting to which we could point. As long ago as 1879, when the Corporation was but three years old, Sir William Siemens was commissioned to place several arc lamps between the north and south piers; if we remember rightly there were nine lamps, each supplied from a separate machine. There have been many changes and developments during the past fourteen years, but Sir William Siemens's installation has been unaffected by the varying fortunes of electric lighting, and during the visit of our representative last week, the lamps were burning as steadily as they ever did.

In spite, however, of the enormous changes in the use of electric lighting, Blackpool, with its new system, still leads the way as regards street lighting. The old generating station lighted the Marine Promenade, whereas the new one provides for the principal streets as well as for private lighting.

The Electrical Fete.

The Corporation, fully appreciating the importance of their electric light system, resolved to celebrate the completion of the generating station by a grand *fête* and holiday.

For this purpose they summoned together many eminent electrical men, foremost of whom was Lord Kelvin. To a great extent the *fête* was marred by the rain, but the chief part of the function, the lighting of the lamps on the sea front, was highly successful. It was really a fine spectacle, when standing at one end of the promenade, one viewed the long line of lamps extending right away to the south shore. The lighting was uniform, and there was an entire absence of disagreeable shadows. The Blackpool Tower, which, by the way, is an extremely graceful structure, was illuminated by rows of incandescent lamps running from the bottom to the top of the tower. The wind and rain interfered a little with the arrangement, but the effect was distinctly pleasing; a large search light placed on the top of the tower added to the general scheme of illuminations.

The Opening of the Station.

The real ceremony of the day was the opening of the generating station by Lord Kelvin. The Chairman of the Electric Lighting Committee (Councillor Pearson), who is mainly responsible for the adoption of electric on its present scale, reviewed the incidents which had led to the establishment of the electric light works.

Lord Kelvin, in declaring the works open, said in the year 1879 Blackpool had the honour of being in the van of progress; they took a step, the extent of which was, at that time, scarcely conjectured by scientific men. They took that step before it was known whether it was possible to extend the electric light not only to streets, but to shops and houses. Blackpool had the great honour of being among the only four corporations which at that time acquired statutory powers for electric light. It possessed the greater honour of being the only corporation which carried those powers into effect. No time was lost in getting to work, and six great arc lamps, each of 6,000 candle-power, were placed on the Marine Parade on poles 60 feet high. The system was old-fashioned now, but it was new then. Dwelling upon municipal enterprise, he thought that corporations were right to take everything into their hands that was good for the borough, without, of course, entering on transactions in distant places. Such a matter as the electric telegraph should, they must agree, be kept apart from municipal corporation, and telephones were practically in the same category. Though the remark was outside the present occasion, he must express the opinion that both telegraphs and telephones should be in the hands of the Government, for they involved a scientific work that was not confined within the borders of a borough. There must be a common arrangement for the whole country, which he considered would not be advancing too far into the question of State Socialism. The Corporation of Blackpool had taken control of the electric tramway. Following that principle, he would venture to say that it would not be improper for the Government of the country to take into their own hands the whole system of railway communication between different towns of the country. In regard to telegraphs, in spite of many evil auguries, the Government had succeeded in a system of national management. With magnificent success, they delivered the parcels of the country. Now, they might take another step, on the general principle that that which private companies could not do well—even the great companies—might be undertaken by the Government. The private interests of a company might easily interfere with the general interests of the community, and it was as well to prevent that state of things arising.

A few more congratulatory speeches were made, and the engines were then started amid the applause of the visitors. An inspection of the machinery was made, after which the company proceeded to the Marine Promenade, where Lord Kelvin switched on the arc lamps, and the new public lighting of Blackpool became an established thing. A banquet was held in the evening at the Clifton Arms Hotel to celebrate the event, the proceedings lasting until a late hour.

The History of the Scheme.

In 1890, the Board of Trade granted to the Corporation a provisional order. The matter, however, was allowed to rest for 18 months, when an electric lighting committee was appointed to consider the necessary course of procedure. An exhaustive report was submitted, in which the scheme of Mr. Robert Hammond was recommended. The sanction of the Local Government Board to borrow money was received in the early part of 1892; five weeks afterwards the foundations were laid. Six months have only elapsed, and the station is quite ready to supply a considerable demand. For this the Corporation are greatly indebted to Mr. Hesketh, the borough electrical engineer.

The System.

The high-pressure alternating current, with house transformers, has been adopted. It is practically identical with the system employed at Dublin. Taking into consideration the peculiar formation of the area, this, or a closely similar system is, perhaps, the best that could have been chosen. The station is situated at about the centre of the area of supply, and adjoins the sidings of the Lancashire and Yorkshire Railway. The buildings are lofty and roomy, the engine-house being 125 feet long by 54 feet wide.

Some regard has been paid to the interior appearance of the station, the engine house being lined with glazed bricks and the roof girders painted in tasteful colours. Ample space is provided for extensions.

The Plant.

The plant consists at the present moment of one 200 H.P. engine driving one 100 kw. alternator, two 100 H.P. engines driving 50 kw. alternators, and three 600 H.P. engines driving three arc dynamos. These are capable of supplying 12,500 8-candle-power lamps, and 165 arc lamps of 2,000 C.P. each.

The Dynamos.

Two of the machines are of the Lowrie-Parker type, and have been built by the Electric Construction Corporation. They are as follows:—One 100-unit alternator working at a pressure of 200 volts with a speed of 375 revolutions per minute, and a 50-unit alternator of precisely the same build designed to give 2,000 volts at a speed of 500 revolutions per minute. The remaining machine is a 50-unit multipolar machine of the Hall-Hammond type, which has been made by Messrs. John Fowler & Co. These machines have been specially constructed to synchronise or run in parallel with each other at all loads. The field magnet and armature conductors do not carry more than 2,000 ampères per square inch of section, thus allowing a good working margin. The bearings seem to be of unusual length, and have large surface; they are provided with a water jacket and water fittings for use in emergencies. The exciters are driven by ropes from a grooved pulley on the alternator shaft, and are each of sufficient size to generate current necessary for the excitation of the fields of the alternators at full load. In order to provide for the perfectly safe working of the plant, the terminals to which the high tension mains are connected are boxed in by polished wood lagging, so that they cannot be touched except by the proper official. The arc lighting dynamos are each capable of lighting 55 arc lamps when driven at a speed of 800 revolutions per minute. They are of the Brush type, and are fitted with the most recent improvements for adjusting the collecting brushes and for working at a pressure of 3,000 volts with a minimum amount of sparking at the commutators. All the alternators and arc dynamos are provided with slide rails.

The Engines.

The engines are the well known horizontal coupled compound non-condensing type, made by Fowler & Co. The speed of the largest engine is 90 revolutions per minute, and the ordinary working load 200 I.H.P. at a steam pressure of 125 lbs. per square inch, but the engine, with an increase of pressure up to 140 lbs., is capable of developing 250 I.H.P. as a maximum load. The chief dimensions of this engine are—high-pressure cylinder 15 inches diameter, low-pressure 24 inches, the stroke being 30 inches. The slide bars and the crosshead shoes have extra large wearing surfaces arranged on each side of the connecting rod; they are made in such a way that easy adjustment is possible without any complications.

Another point in these engines worthy of note is the massive character of the bed-plate, a characteristic not found where the strength of the plant has been subordinated to economy. The strength of the crank-shaft and the length and surface of the bearings are also notable features, as are also the size and weight of the fly-wheel. Great care has been exercised in providing for the lubricating arrangements; the supply of oil being regulated, caught after first use, conveyed to a suitable reservoir, filtered, and used again. The engines are securely railed in, and between the foundation pillars and over the pipe trenches chequered-iron foot plates are placed, giving the whole a very neat appearance. The fly-wheels are all grooved for rope driving, this being found the most easy and economical method of working. The ropes on the 200-H.P. engine are 1½ inch diameter and are eight in number.

The two 100-H.P. engines are run at a speed of 120 revolutions per minute, the high-pressure cylinder is 11 inches diameter, and the low-pressure 18. The length of the stroke is 20, and the fly-wheels are 10 feet in diameter, grooved for six 1¼-inch ropes.

The three smaller engines are run at a speed of 150 revolutions. The high-pressure cylinder is 9 inches in diameter, the low-pressure being 14. The stroke is 16 inches.

The Switchboards.

The switchboard in the Lowrie-Hall system is usually placed in a separate room, but at Blackpool it is fixed on one of the walls of the engine room. It is constructed according to the Lowrie-Hall patents, and in many respects is similar to those used in the central stations at Madrid, Leeds, Brighton, and other places. The switching arrangements allow of the usual flexibility in switching a machine on to any circuit. A synchronising board is provided for parallel working. We understand that the alternating plant will be usually run continuously in parallel. The cables from the dynamos and from the outside circuits are brought to the rear of the switchboard, where ample space is left for inspection and other purposes. The arc light switchboard is made to deal with three circuits, and is complete with the necessary instruments for ampèrage and voltage.

The System of Distribution.

Stranded copper cables are used for distributing purposes. They are insulated with vulcanised India-rubber, and are laid in pipes. Junction or service boxes are fixed at intervals. Each junction box has a loose cover, held in position by a wrought-iron clamp. Connections from the culvert to the consumer are usually laid in wrought-iron pipes. The surface boxes are in all cases placed at the corners of the road, and in the case of a long straight run they are placed at distances of 80 yards apart. The surface boxes are made in two parts, the bottom part being permanent, and the upper part, with the cover, being adjustable, so as to allow its surface to be raised or lowered as the road level may vary, the lid being filled in with wood, macadam, or pavement, according to the construction of the road. The drawing-in system is used, the cables being drawn in from the surface boxes. When passing round corners the cable is placed on a revolving drum, which prevents abrasion. The length of cables laid is about 14 miles. At suitable points the mains are divided into sections.

The farthest distance at which current is at present supplied is about two miles from the works.

Boiler House, Steam Piping, &c.

The boiler house is extremely large and lofty, being 124 feet long by 54 feet wide. Three Lancashire boilers, made by Galloways, are at present installed; they are 28 feet long, 7 feet in diameter, and are constructed for a working pressure of 140 lbs. per square inch. Proctor's mechanical stokers are employed, and one boiler is fitted with Proctor's moving fire-bars. Meldrum's system of forced draught, which we described a few weeks ago is, we notice, in use. The usual feed-water heating system is provided. The donkey pumps for feeding the boilers are of the duplex ram type, each of sufficient capacity to feed two boilers when working at their full power.

The main steam pipes are connected up in the form of a ring, to which both boiler and engine branches are connected, thus providing two ways by which the engines can be supplied with steam. An auxiliary steam pipe is provided for supplying the pumps and stoker engines, independent of the main steam pipe.

These pipes are provided with a suitable number of stop valves placed between each engine and boiler. The pipe forming the main steam ring is 10 inches diameter, and is carried on brackets fixed to the wall of engine house. The branch pipes to the engines are of wrought-iron, with wrought-iron flanges.

The whole of the system of steam pipes was tested by hydraulic pressure to 300 lbs. per square inch after erection in the works. The exhaust pipes lead off from under the low pressure cylinders, and a stop valve is provided to each engine exhaust to shut it off from the main exhaust pipe. Valves are arranged so that the whole or part of the exhaust steam can be turned through the heater or direct into the atmosphere through the roof of the boiler house.

The whole of the plant has been supplied by Mr. R. Hammond.

Will the Station Pay?

The prospects of the station as a dividend-earning concern is of the utmost importance to the town authorities. It is, of course, difficult to determine the exact value of street lighting by arc lamps. We think that it ought to stand higher than the mere cost of gas lighting which is displaced, particularly in a town like Blackpool, where electric lighting in the streets could be fairly reckoned as an attraction.

Private lighting should undoubtedly provide a better source of revenue than is usually obtained from this class of lighting. We have inspected two or three load curves that have been obtained, and they show a state of things calculated to raise the envy of a central station engineer. About five o'clock in the afternoon the curve ascends almost vertically, and keeps fairly regular until nearly ten. This is accounted for by the fact that the shops usually remain open until ten. The Winter Gardens, in which theatrical or other performances take place every evening, have nearly 1,500 incandescent lamps and a large number of arcs; this, no doubt, will help very materially to steady the load curve. The price charged is 6d. per unit. 101 arc lamps are burning regularly on the Marine Parade, in addition, 55 are used by private consumers. At the present moment 5,600 incandescent lamps are installed, the capacity of the station being 12,500 8-C.P. lamps. Up to the present £28,000 has been spent, and it is the intention of Mr. Councillor Pearson to ask the Council to obtain further borrowing powers for an extension of the plant.

A MECHANICAL SYSTEM OF ELECTRIC CONDUCTORS.

These conductors were designed by Messrs. Cook, Smythe and Payne, and the following information was given in a paper, read by Mr. Ernest Payne, before the British Association, with the object of providing a system that should be free from the objection sometimes urged against the covered wires and wood casings, that they are not composed of fireproof and imperishable materials, like the waterpipes, gaspipes and fixtures used in the interiors of houses and public buildings.

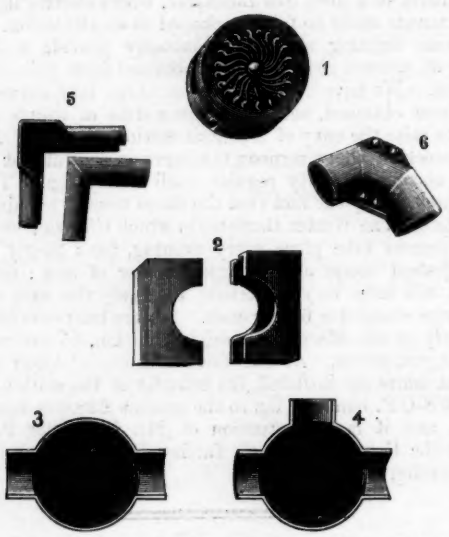
The first conductors used were arranged on the concentric principle, and consisted of tubes placed one inside the other, and separated by means of insulating rings (usually of porcelain) placed at intervals along the tubes, or by means of porcelain studs fitted into small holes made in the tubes at intervals.* There were also designed a number of junction boxes and supports for holding the conductors and fittings connected with them. Some of these are shown in figs. 1, 2, 3, and 4. These boxes are made usually in two halves, so that they can be fitted round the ends of the tubes after the joints are made in the conductors.

When the boxes are not employed, L and T-shaped junctions are used; a large variety of these have been made, some of castings and others of stampings made with press tools; two of these are shown in figs. 5 and 6.

For breaking the metallic continuity of the outer tube, which is not used to carry current, an insulating support may be employed; one of these made to work with ceiling roses, switches, cut-outs, &c., of the usual types, is shown in figs. 7 and 8. The fixing of the insulators to the conductors was the chief mechanical difficulty to be overcome. It was the firm's object from the first to fix the insulators to the conductors in the workshop and send them out ready for erection. By employing a tubular strip of copper, not brazed or soldered along the edges, the insulators were fixed to this either by forcing them inside or outside, as required, the rings being held in position by the spring of the metal. This was improved upon by making the inner and outer insulators of such sizes that an outer ring would not pass along over a point where there was an inner ring inside the tube, so that they could be pushed inside and outside alternately, and hold firm by the mutual inward and outward

*This arrangement was described in our issue of March 18th, 1892, and a photograph of the Mediæval French Court at the Crystal Palace Electrical Exhibition, which was fitted with these conductors for Messrs. Benham & Froud, Limited, was reproduced in a later issue

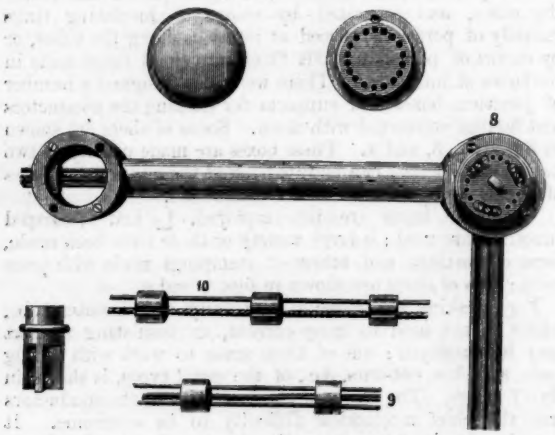
pressure against the tubular strip. The inner and outer rings were thus fixed to the middle tube, after which a central wire or rod could be pushed through the holes in the inner rings, and the two together placed inside the outer tube or guard. This formed a very rigid combination, and there was no chance of earths or short circuits. Several of the concentric circuits in the offices of the City of London Electric Lighting Company are arranged in this way.



FIGS. 1 TO 6.

By employing two strips of semicircular section, and providing the insulators with projections to keep them apart, the outer conductors form two circuits and the inner rod can be used as a common return. This arrangement is also suitable for vertical mains when arranged on the *three-wire system*.

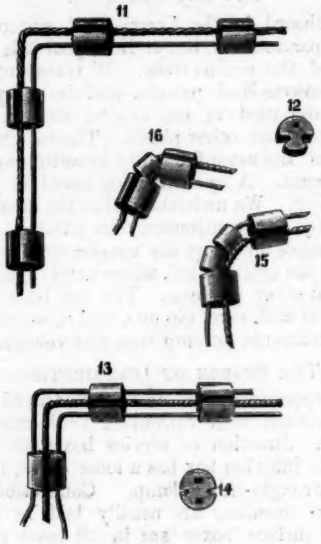
Numerous experiments were made with a view to devising some good methods of fixing the insulators to ordinary copper wires, and the firm adopted the plan of making the



FIGS. 7 TO 10.

insulators with holes or grooves in them, as illustrated in figs. 9 to 16, so that the wires could be drawn through the holes or laid along the grooves and the insulators fixed by twisting the wires together; other conductors, wires, strips, &c., can then be drawn through other holes of suitable size and section for other circuits. Fig. 11 shows a single lead and return; fig. 13 shows two leads with a central return composed of two twisted wires; fig. 9 shows four circuits with twisted central return. The wires and insulators can be made up in long lengths, and sent out coiled up like the usual covered wires; the outer tubes can be cut and erected separately, and the wires drawn through afterwards, or they can be sent out complete with the wires inside. In the latter case, nearly all the work can be completed in the workshop, which is very advantageous where work has to be done in business premises and cannot be carried on during the day time.

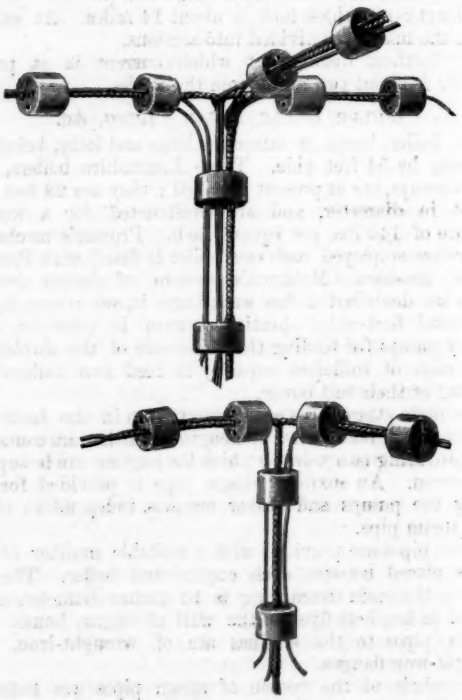
In some cases it is convenient to make a joint in the conductors separately, as shown in figs. 17 and 18, and then joint



FIGS. 11 TO 16.

the longer wires to these and cover them with sleeves; these junctions can be made up in numbers and kept in stock.

The multiple mains form a very prominent feature in the system. For supplying current to the different floors of a building—for flats, hotels, &c.—a separate wire can run up



FIGS. 17 AND 18.

from a distribution board to each floor, all enclosed in one tube. The central return can also be stranded, one or more being dropped at each branch. No soldered joints, therefore, will be necessary.

The L and T junctions, and also the junction supports, already described, can be used in combination with the wires or with the concentric tubes.

When the exact position of a bend is known, and very careful insulation is wanted, small insulators can be threaded on the wires at the bend, as shown in figs. 15 and 16.

Where necessary, an insulator with two or more grooves in it, according to the number of wires, can be inserted exactly at the bends if it is found necessary. Messrs. Cook, Smythe and Payne have also designed several insulating junctions for the tubes, made, usually, in two parts for L's and three parts for T joints. They are fitted on round the wires, and provided with semicircular projecting parts that fit inside the ends of the tubes, which are pushed on to them, and thus hold the two parts firmly together.

With regard to the insulation of these conductors, it should be pointed out that when bare conductors are employed for interior wiring, the difficulties met with are not so hard to overcome as those encountered in underground conduits. The interior of a building is usually dry, the temperature generally higher than that of the air outside, and it has been found, after two years of practical experience, that one does not get the condensation that is sometimes said to take place when warm moist air finds its way into a cold conduit. In the case where rows of lamps are fitted on tubes and used for shop windows or stage footlights, the heat of the lamps causes circulation of warm air round about the insulators and keeps the insulation up at a high figure.

LEGAL.

Singular Action Against Electrical Engineers.

In the Westminster County Court, last week, the case of Congden *v.* Sambridge & Son, came before Judge Lumley-Smith, Q.C., and a jury, and was an action brought to recover damages for breach of contract, under most unusual circumstances.

The plaintiff is an agent for electrical fittings in London, and the defendants manufacturers of fittings at Highgate Street, Birmingham.

Mr. Kirby was counsel for the plaintiff, and Mr. Abinger for the defendants.

In opening the case, counsel said the defendants were makers of gas fittings and desired to enter into the electrical trade. Arrangements were made by which the plaintiff was to act as sole agent in London for the defendants in electrical fittings, and was not to sell anyone elses. For this he was to have 10 per cent. commission, and defendants were to supply him with samples and to deliver the goods. Plaintiff had a large connection, and his chances of getting orders were great. The commission was to be on the turnover in London. Plaintiff upon that took a London showroom. The first complaint was as to supply of samples, which were never of the value of more than £50, which was not enough. The value should have been at least from £200 to £300. Plaintiff had got orders amounting to about £600, and had received £30. The turnover was estimated at about £3,000. Most of the goods were badly executed, and it was through that that the plaintiff put an end to the arrangement.

His Honour said it appeared to him to be impossible to complete the case, and suggested that some one should be appointed as arbitrator.

The suggestion was not accepted, and Charles Lowndes, of the Electrical Fittings Company, Limited, gave evidence that the samples at the plaintiff's showrooms were not enough, and the orders he gave were not properly executed, and between three and four months was occupied in delivering it. This was a trial order, and he would not give any more because this was not properly executed. They supplied samples to the value of £100 to a firm who turned over about £700 a year. The samples plaintiff had were not enough for such a turnover as was expected.

Cross-examined: Their order was to the extent of about £40.

Alfred Edward Jacobs, manager of Edison & Swan, said he saw the articles several times, and there was not enough for such a turnover as was expected. The showroom was at Palace Chambers. He gave several small orders, but they were not satisfactory. The value of the samples for such a turnover as was anticipated should have been about £200.

Cross-examined: Birmingham goods, generally, were not as good as those made in London; they were not so well finished. Some persons gave orders from pattern sheets, but not very often. There certainly was not £100 of samples hanging up.

By His Honour: Some of the Birmingham makers supplied good finished articles as good as London firms. He bought from samples.

Mr. Josephs, of the firm of Burton, Birbech & Josephs, was called and sworn, but Mr. Kirby did not examine him.

Cross-examined: He gave several orders to the plaintiff on behalf of the defendants. The defendants were now known in the trade, but he did not know that they were the contractors to the London and North Western Railway Company. He had a high opinion of Birmingham goods. Some of the orders were given from samples and some from printed sheets. Some of the articles were, he believed, returned. The number of samples depended largely upon the traveller.

Mr. Allen said he was now in business on his own account as an electrical engineer, but, at one time, was in the employ of Messrs. Barclay & Son, deposed to giving orders to the plaintiff and said they declined to give them further orders because the goods were not delivered to time.

Other witnesses having been called,

The Plaintiff gave evidence in support of his case and deposed to complaints from many persons and said the value of the samples sent him never exceeded £87, and some of these were delivered to supply an order so that he had not the whole of those samples at one time. A new arrangement was discussed, and one item was that he was to have samples of the value of £100. The complaints were many.

His Honour said the fact that there were complaints went for nothing, because complaints were made for the purpose of getting discount.

Continuing his examination, he said he opened 30 accounts and 13 never went beyond the first order. The reason they never went beyond the first order was because the orders were badly executed. He was now agent for another firm and had got orders from some of the lines.

Cross-examined: The main cause of the bother was not because they would not pay commission before he earned it: Mr. Sambridge agreed to allow him to draw on account. It was clearly understood that he was to pay for the showroom himself. The real reason for this breach was not because defendants would not keep advancing money. He did not have samples to the extent of £194. He sent 137 orders in the seven months of the agency. It was to the interest of the defendants that they should make a success of it. So far as he knew no action was brought against the defendants by any of the customers.

Re-examined: Although there were 130 orders, they were all from 30 persons.

By His Honor: He terminated his connection with the defendants in July, and he did not now claim commission. It did sometimes happen that firms gave a first order to get rid of the canvasser.

The defendant, Geo. Sambridge, said the plaintiff had several commissions besides theirs, and some £200 worth of samples were sent to the plaintiff. No action had been brought against him in reference to this matter. There had been a few complaints. He had been in business 25 years. For six or seven months no money was received. Plaintiff had had about £50, and the cash received for orders was about £400. Samples had been regularly supplied. Plaintiff became very pressing for money.

Cross-examined: There may have been £520 paid to them. At the end of last year he had paid the plaintiff £30, but no money at all was received by them. The samples were left to his discretion and there were a few complaints, but only a few. They had had orders from several firms since the plaintiff left them.

Arthur Howard Wilkes, manager of the defendants' firm, gave corroborate evidence.

The Jury, after being addressed by Counsel and His Honour, gave a verdict for the defendants, and judgment was given accordingly with costs.

THE RECENT FATAL ACCIDENT AT BLACKFRIARS.

Mr. A. C. Langham, Deputy Coroner for Southwark, resumed, at Guy's Hospital, on Monday, October 16th, his inquiry into the death of Frederick William Ball, 34, who was killed by electricity at the local station of the London Electric Supply Corporation, Limited, Blackfriars, on the 12th ult.

Major Cardew watched the case on behalf of the Board of Trade; Mr. O. A. Skinner represented the Home Office authorities; Mr. Gilbert appeared for the Electric Corporation; and Mr. Hurd was present on behalf of the widow.

The deceased, between six and seven o'clock in the evening, was found lying dead between two converters and a stool. One of his hands was touching the stand of one of the converters, and the other was lying across his leg. Another man named Ernest Meech was also lying injured on the ground. Meech exclaimed to a witness, "For God's sake come and help us. I was dusting when they turned the main on." The two men were working an eight-hour shift at the time of the fatality. A witness named Freeman, who tried to find out how the calamity happened, found a duster lying on the terminal of No. 42 transformer, which was connected with the omnibus bar, the deceased having evidently left the omnibus plug on when it ought to have been off. Had it been off the accident, it was said, would not have happened. It was the duty of the deceased, at half-past six every evening, to turn the plug off in order to get a supply from the Deptford main, so that the other might be cleaned. He had always been a careful man, and no one was to blame but himself. Mr. Patrick Walter D'Alton, engineer-in-chief of the London Electric Supply Company, stated at the last examination that the occurrence was, no doubt, the fault of the deceased in leaving the plug in. Mr. E. T. E. Hamilton, house surgeon at the hospital, said that on examining the body, he found there was a ragged wound, down to the bone, at the back of the right wrist and hand, and the flesh was charred. There was a similar, but smaller, wound at the front of the left wrist. The injuries seemed to have been caused by electrical contact, and the shock was quite sufficient to cause immediate death.

The names of the jury having been called over, the Coroner said that the man Meech was still lying in St. Thomas's Hospital, and he

had received a certificate from the surgeon to the effect that it would be some weeks at least before he would be able to attend. As the inquest had been adjourned for his appearance and he could not now appear, it would necessitate another adjournment. There was, however, other evidence forthcoming, and they would proceed with that at once.

James Clark, a bricklayer's labourer, of North Street, King's Cross Road, said that he was for 18 months in the employ of the Company at each of these stations. He was at the one in Blackfriars Road when the occurrence happened. There was an accident there in August or September, 1891. Witness was present at the time. He was working with some men when he heard reports, and the scream of a man in danger. Some of the men ran towards Blackfriars Road, away from the premises, but he (Witness) remained, and on going into the working room he saw a man named Ponjoy with his eyes nearly out of their sockets, and his arms extended in a very peculiar manner. There was what was termed an arc, with a piece of cable burnt or broke in two. He seized the man by the wrist, but no sooner had he done so than he himself was fixed, and could not move. The man seemed to be free at once, and leapt up, partly pulling him with him. Witness fell to the floor, when two men came from the yard, picked him up, and led him towards the gate. Several attempts were made to communicate with the telephone in a room, but the men who attempted it were driven back. The whole atmosphere by the door seemed to be charged, and they could not get within eight feet of it. The electric fluid got to the outside and cleared the whole of the stack pipe. Witness called a cab and drove to the Trafalgar Station, so that the men there might communicate with Deptford. By the time he got there the connection with Deptford had been switched off, and that enabled the men to communicate. The injured man was scorched on the head, but Witness did not receive any injury. He had heard that a boy named Mara had once been injured at the works. Another accident, he had heard, had happened to a man named Bungary, he having got a shock off the switch. His hand was burnt, but he did not stay away from his work.

A Juror: Was the man wearing gloves at the time he received the shock?

Witness could not say, but he thought that all the men had not gloves supplied to them.

Do you think that the station at Blackfriars was carried out in a proper manner?

The Coroner: How can a bricklayer's labourer answer such a question?

The Juror: Do you consider that it was dangerous employment for a boy to work at?

Witness: I do. I would not work there for £1 a day.

You consider it terribly dangerous, then, for a boy to have anything to do with the converters.

Witness: I do. I think they ought not to have boys there at all.

Another Juror: Do any of the men wear India-rubber shoes?

Witness: I think that boots of that kind were supplied to men some time ago.

John George Freeman, of Red Lion Yard, Cockspur Street, recalled, said, in answer to the Coroner, that the strength of the current was 10,000 volts, as it came from Deptford into the station. Then it was converted into 2,400 volts, and at that pressure was sent out into the streets. Witness could not say what strength would kill a man. That was a point on which a difference of opinion existed. The strength on the omnibus bars would be 2,400 volts. The Blackfriars was simply a converting and distributing station. There was no rule about the workmen wearing gloves. There was no need for it amongst the ordinary workmen. All the metal could not be insulated on the omnibus bars. The switches were of bare metal.

Major Cardew inquired if it was possible to protect the omnibus bars, so that a man could not accidentally touch them.

Witness did not think it possible.

A Juror: Was it safe for strangers to go into the works?

Witness: I think so. A policeman has been in, and he did not suffer.

Mr. Hurd: Do you know that a man named Cragg met with an accident in 1892?

Witness: I have heard that he got a shock, but I cannot say how far he was injured.

Mr. D'Alton, the engineer-in-chief, recalled, said it could not be determined definitely how many volts would kill a man. It was a question of quantity as well as of pressure. If a man took hold with each hand of the two ends of a cut wire, the current would pass through his body, and in all probability would kill him. It had been tried to kill a murderer with 1,000 volts, but it had not succeeded. As far as they knew of the present case, the current must have passed through both men, killing one, and injuring the other. He had never heard of any previous fatal accident at the works of the company.

Mr. Hurd: Do you remember an accident happening to a man named Auburn?

Witness: I do not remember the name. There was a man named Allchin.

Would not the use of gloves prevent accidents to men when touching exposed wires?

Witness: I do not think it would be safer. Men could take a more sensible precaution at an earlier stage than wearing gloves. India-rubber was not a perfect insulator. If it was a question of a man cleaning anything that was likely to be charged, gloves might be of advantage. Meech met with the accident whilst dusting the live terminal. So far there had not been more than eight or nine shocks or burns to their men during the last three or four years.

A Juror: Are all the men supplied with India-rubber gloves?

Witness: Yes, and with shoes too. They are a safeguard certainly in some respects. Ball had India-rubber shoes on when found.

It was stated that Meech was progressing satisfactorily.

The Jury expressed a wish to visit the works, and their request was at once acceded to.

The mother of Meech said that she understood one of the hands of her son whould have to be amputated.

The Coroner adjourned the inquiry until January, 1894.

ACCUMULATORS UP TO DATE.

The great importance of storage batteries as adjuncts to electric lighting, be it for the purpose of ensuring steadiness in the light, easy regulation, or economy in production and distribution—especially in central stations—or, again, in their application to the electric propulsion of vehicles, rightly called "the ideal mode of traction," is sufficiently, we may say almost universally, recognised by electrical, civil, and mechanical engineers, so that a careful examination of our present position with regard to the quality in which these appliances are obtainable appears to us to be warranted, and most likely to be productive of good to both users and manufacturers. What we have to determine is whether, and if so to what extent, progress has been made of late years in the manufacture of accumulators in raising their efficiency and durability to a level at least with the generating plant, and to facilitate arriving at a conclusion, let us first state briefly what we may reasonably demand of a secondary battery, and then see in what measure these expectations can be complied with. We could name a number of electrical engineers—old established and well known firms among them—who, while fully aware of the many advantages which can be derived from storage cells, have in consequence of adverse experience or through lack of confidence in them, or both, entirely abstained from their employment for years, but real demonstrated progress is destined to wear down prejudice, and our aim has always been to assist in this progress wherever we can do so conscientiously.

The desirable qualities in a set of accumulators for stationary purposes should be the following, viz.:—

1. An average lifetime of 10 years, while retaining at least 75 per cent. of their original capacity. 2. That the electrodes be of robust constitution and offer ample paths for conducting the current. 3. That the number of electrodes in a cell should be small, capacity for capacity, with low internal resistance. 4. That the dropping out of active material, buckling of the plates and consequent short-circuits, be impossible. 5. That the cells admit being fully charged in three hours, and completely discharged in one hour, if need be. 6. That prolonged rests have no deleterious effects. 7. That discharges, even until there is no potential difference, do not damage the cells nor impair their capacity. 8. That they require no attention beyond charging and filling with electrolyte. 9. That they occupy as little space as possible. 10. That the efficiency of the cells be high. 11. That their price be moderate.

For traction purposes, it is requisite that in addition to the above-mentioned qualities, the cells should be able to withstand continued mechanical vibration, without this loosening of the active material; they must be capable of even higher discharges for short periods, equal to a complete discharge in half an hour, and, while strength of electrodes is more essential here than ever, the weight should be small. The difficulty of retaining the capacity of cells used for traction, in consequence of the perpetual wash of the electrolyte along the surfaces of the plates, must be overcome, making it practicable to stipulate a minimum lifetime, depending on the nature of the work and local circumstances. These conditions must be weighed in individual cases before decision as regards life can be arrived at, when a suitable maintenance guarantee is usually agreed upon with the makers. The cost of renewals, which in time will become necessary, is then, as a rule, expressed by a certain value per rate of work done, which should compare favourably with other modes of mechanical propulsion, and, in any case, be cheaper than animal power.

The foregoing specification of qualities in accumulators will, we think, be readily admitted as satisfying the most exacting demands, and it remains, now, to investigate whether realisation of these requirements is attainable.

In order to form our own opinion, we have carried out a

series of rigorous tests on a number of Epstein cells over a period of five months, with intervals for the purpose of watching the results of prolonged rests. The outcome of our tests cannot be said to be otherwise but highly creditable to the makers of the cells, and corroborate the favourable experience expressed in Prof. Ayrton's report in July, 1892.

To proceed in the order of our qualifications :—

1. The manufacture of Epstein accumulators dating back but two and a-half years, their condition after 10 years' use can at present only be surmised, but taking the maker's word, which, from our experience we have no reason to doubt, that not a single plate in any of the numerous stationary batteries erected in the course of this time has been replaced or even repaired, and judging from their present exemplary condition, a very long lifetime may be safely predicted. Moreover, the makers' maintenance guarantees of 7½ per cent. in London, point to an anticipated life of over 13 years, and the results shown by their 12 batteries in use on the Birmingham Central Tramways, which have now completed 100,000 car miles without any renewals, furnish undeniable evidence of remarkable lasting powers. The problem of retaining the capacity of cells used for traction work has, we understand, found its solution in a very simple process recently patented by Mr. Epstein, the application of which effectually checks any impending decrease in capacity, and secures the full output until such time when the said process is repeated. The limit of this treatment lies in the mechanical strength of the plate.

2. The Epstein plate consists of one solid lead casting, with corrugated surfaces and a webb of metallic lead throughout the centre of the casting, furnishing an ample conductor to the current, the lug being cast in one piece with the plate.

3. The surface developed by means of the corrugations on the plates is five times as large as the plain surface, consequently the number of electrodes for the same output as other cells is much smaller—the cells tested by us had only three electrodes (one positive and two negative)—the internal resistance being about ·003 ohm.

4. The active material on Epstein plates is produced by direct oxidation of the pure metallic lead of which the castings are composed, and without the use of paste in any form whatsoever. By a preliminary boiling process, as ingenious as simple and effective, the surfaces of the plates to a given depth are rendered porous through expanding the lead fissures which, upon the electrical formation taking place, enable the active material to key itself inseparably into the metallic lead, making perfect contact throughout. The flaking off of the active material cannot, therefore, occur, and as its distribution is absolutely uniform, the resistance at any point and on either side of the plate being equal, the possibility of buckling is likewise entirely avoided.

5. The charging during our tests was regularly effected in three hours, and although we did not take any discharges at specially high rates ourselves, we have seen proofs that cells on the Birmingham Central Tramways, having a capacity of 130 ampère hours at 65 ampères, were discharged last winter at rates exceeding 200 ampères without any damage resulting.

6. We made a point of proving the correctness of the Epstein Company's assertion that prolonged rests do not affect their cells, and that in the absence of electrical action no chemical changes take place, and found this to be the case. We noticed no decrease in capacity.

7. Discharges until the P.D. had fallen to 0 were made by Prof. Ayrton in his tests, and again by Prof. Perry, as a member of the jury at the Crystal Palace Exhibition, a rest of several hours being given in each instance before the next charge, but the cells remained perfectly unaffected thereby.

8. The cost of supervising a battery, by a skilled man, in order to prevent lasting injury by subjecting each cell to careful examination day by day, is an important consideration, and a saving in this respect will be readily appreciated. We have not attempted to take care of the Epstein cells under test, but rather neglected them purposely, and can fairly say that provided they contain sufficient acid they will work without any further attention.

9. Owing to the small number of electrodes, the cells require little room, which fact particularly tells in their favour for traction work, the weight being also correspondingly reduced.

10. The quantity efficiency was found to be 95 per cent., and the energy efficiency 78 per cent., when the cells were charged and discharged in three hours.

11. In the matter of prices it is, of course, impossible to dictate to the manufacturers who, unlike us, know the cost of production, and will use their business experience to regulate the charges so as to bring their articles within the reach of customers. Reliable, efficient and durable accumulators, like other first-class plant, will, no doubt, always command good prices, and quality should ever be the first consideration where engineers take pride in their work, and are ready to stake their reputation on the faultless manner in which it is carried out.

Drawing conclusions from the foregoing particulars, we have the satisfaction to notice conspicuous progress in the manufacture of accumulators, and can assert unhesitatingly that storage cells now at the disposal of engineers have completely emerged from the state of laboratory apparatus, fragile, expensive and difficult to handle, into sound, reliable pieces of machinery, capable of doing the work well, and with a minimum of attention, and the annual depreciation rate of which compares favourably with that of any part of the generating plant.

CORRESPONDENCE.

Arc Lighting.

I am greatly indebted to Mr. Albion T. Snell for his kindness in pointing out what is certainly a very bad piece of ambiguity in my numerical example of my formula for the economic section of a conductor. The example occurs on page 650, Vol. xxxii. The whole trouble lies in that 1,000, for it is not clear what reason there may be for introducing it into the formula. The length of the cable selected is 1,000 feet, but I have expressly said that the length will always cancel out; whereas, it looks as if the 1,000 were meant to represent the length. As a matter of fact, that 1,000 is introduced to bring the energy to Board of Trade units; as, if we take the resistance in ohms and unit current density, we shall have the energy wasted in watt-hours unless we also divide by 1,000. So the 1,000 has nothing whatever to do with the length. Let us start afresh, with another example. Take a yard of the same quality of cable; its resistance per square inch section will be 0·0000256 ohm, and with unit current density there will be 0·0000256 watt-hours wasted per hour, or, dividing by 1,000, there will be 0·0000000256 B. T. units wasted per hour. This, then, is the value of w. Now, suppose that we wish to transmit 200 H.P. at 1,000 volts; that the cost of one entire H.P. year is £30 (this is for 8,760 hours, it is important to observe); and that the cost of additional copper is at the rate of 15 shillings per square inch per yard length, the interest being reckoned at 6 per cent. Further, since the power will certainly not be required during the whole of the 8,760 hours, let there be a load factor of 20 per cent. The values of the separate quantities will be :—

c = 150 ampères.
w = 0·0000000256 B. T. units = 2·56 10 B. T. units.
z = 30 pounds.
f = 20 „
p = 6 „
k = 15 shillings = 0·75 pound.

These values, if introduced into my equation will give the value of the section of copper, the result being 0·304 square inch.

Turning now to the method which I adopted to obtain the value of the constant for the formula, I have again to express my indebtedness to Mr. Snell, for his letter has led me to carefully revise my original working and to unearth an important error. I find that the constant should be 1·168 instead of 0·873. Once this constant is correctly determined, it is a simple matter to use my formula; but there are several complicated calculations involved in its evaluation. Mr. Snell asks me how I get my constant. I do so in the following manner :—From a set of Forbes's tables I select the set of values which correspond to an average example of power transmission. These values I modify to suit the system of

units in my own formula, changing the cost of a ton, for example, into the cost of a square inch section one yard long. Having thus adapted Prof. Forbes's values to my own quantities, I insert them in my formula; leaving, as the only unknown quantity in the formula, the constant which is placed before it and which connects it with Forbes's set of values and with Thomson's law. Then I solve the unknown quantity, which, of course, gives me the value of the constant. I believe this is the usual method of getting a constant when the law of variation of the variables has once been determined; and it is obvious that a *constant* thus determined for one special case must be true for every possible case which can be included under the law expressed by the equation.

In conclusion, I wish to emphasise the fact that my load-factor formula differs in this much from the usual formula, that it is only true for circuits with a constant current supply. It is utterly inapplicable to cables which have a widely varying current; and I believe I have made this clear in my treatise on "Arc Lighting." The reason is that the load factor in variable current working, with constant pressure, does not express the dissipation factor of the mains, because the load increases as the first power of the current and the dissipation as the second power. It is impossible to connect them by means of a single quantity representing the load factor of the useful work; so that my formula is only serviceable in constant current problems. The load factor is, in such cases, merely the fraction of the entire year during which the current is in the cable. It is gratifying to find that so experienced an engineer as Mr. Snell can find that my formula is "the most practical form" of the economic law; and I have again to thank him for enabling me to make it, not only practical in form but in numerical magnitude also. I hope that in its redressed and now correct form

$$s = 1{\cdot}168\, c \sqrt{\frac{w\,.\,z\,.\,f.}{p\,.\,k\,.}}$$

this formula will be of service to electrical engineers.

E. Tremlett Carter.

"Jerry" Wiring.

I was much interested in your illustration of jointing, especially as I was called in only this week to overhaul an installation fitted up two years' ago in this town by a well-known London firm of electrical engineers, and I was much surprised to see the way in which the fittings in the shop window were wired. I send you herewith a sample piece, just as it came out of a brass tube fitting; you will observe that in the short length of 18 inches there are no less than four joints made on each piece of flexible—some soldered, some not soldered. You will also observe that several different coloured wires have been used—rather a good way, though novel to me—of using up short ends of flexible. I send you this specimen for what it is worth, as I thought you would be interested in seeing it; this is not the only piece I found, for there were several other lengths just as bad.

By the way, is there nothing that can be done to stop the jerry wiring that is going on everywhere, which must, and does, bring a bad name on the electrical profession? It seems to me that some steps ought to be taken.

Brighton. **Wm. E. Hayne.**

Lightning Express Railway Service.

I have read with much interest your article on my proposal for "Lightning Express Railway Service." I should be very pleased indeed to be able to discuss this matter with the writer of that article. I have gone a good deal more into the question of electricity than may be apparent from the pamphlet. If you carefully look at the whole framework of that pamphlet, you will see that the object I had in view was to arrive at a conclusion as to the best and safest lines to be used, and the best motive power to be employed, without giving all the details of designs of different parts beyond that which was absolutely necessary.

F. B. Behr.

[A discussion could only benefit our readers if carried on through the medium of our columns. Perhaps Mr. Behr will kindly tell us in that way where we are at fault.—Eds. Elec. Rev.]

A Rheostat for Incandescent Lamps.

With reference to the conclusion of your highly interesting article on "A Rheostat for Incandescent Lamps," in this week's Electrical Review, I should like to mention in reference to the method shown in fig. 3 of your article, that I have for some time since recommended the use of the "Unique" switch for this purpose to its numerous users, and it would be interesting to know if it has been adopted and with what result, as it would be useful in many instances where economy of current is an important factor.

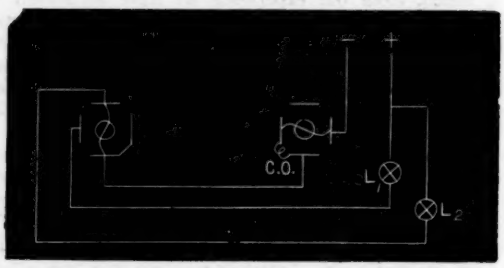


Fig. 1.

I append herewith a sketch of the circuit as arranged for this purpose. In fig. 2, A′ is a "Unique" switch arranged for two-way circuits, B′ is an ordinary single-way "Unique" switch, C O represents the safety-fuse introduced. L_1, and L_2, are two lamps, of which only L_1 is burning under ordinary conditions at full candle-power. On turning switch, A′, the other lamp, L_2, is introduced in circuit with it, causing both lamps to burn faintly during the time required.

A quarter-turn of switch, A′, extinguishes L_2 and causes L_1 to burn at full candle-power again.

A quarter-turn of switch, B′, extinguishes both lamps.

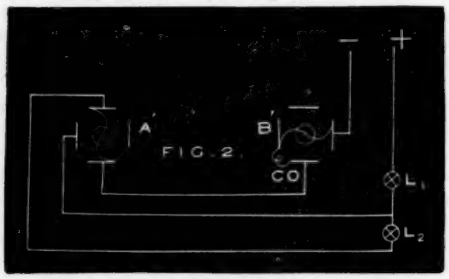


Fig. 2.

Instead of introducing L_2 in series with L_1, it may in some cases be more preferable a higher resistance lamp, or a lamp containing a high and low resistance filament might be used.

In these instances the high resistance filament could be arranged to give any desired intensity of light.

Fig. 1 shows the sketch of the circuit using a separate high-resistance lamp, the current passing through L_1 only when full candle-power was required. The use of high and low resistance filaments in one lamp bulb, I should think, would be most satisfactory.

Gns. C. Lundberg.

October 16th, 1893.

Driving Dynamo by Gas Engine.

I shall feel grateful if, through the medium of your valuable paper, you will give me your opinion on the following matter. I have a 1 H.P. nominal Crossley's gas engine driving a Gülcher dynamo. The engine runs at 240 revolutions per minute, and has a fly-wheel 4 feet 7½ inches by 6 inches, and, weighs about half-a-ton. I am troubled with oil creeping from the bearing on-to the fly-wheel, not gradually, but almost as soon as the engine has got well started. At the end of a three hours' run the wheel is deluged with oil, and, of course, the belt suffers.

I clean the wheel every night after stopping. On the boss of the fly-wheel next the bearings there is a groove cut, I suppose, to throw off the oil; but the edge of this groove is almost exactly in a line with the edge of the fly-wheel, and it seems to me that as the oil is thrown off it strikes the edge of the fly-wheel, and then creeps over into the face of it. Can you suggest a remedy for this?

The engine is also fitted with the ordinary pendulum governor, and, for some reason, this governor acts most erratically. I have 14 to 16 C.P. lamps always in circuit, and others are thrown on now and then, as required, but *never* more than 16 lamps in circuit. Some nights, and even during part of a night sometimes, the governor works splendidly, taking every other impulse, sometimes two, and occasionally three consecutive impulses. At other times as many as nine or ten consecutive impulses are taken before the governor throws off, and then, perhaps, for a few minutes the usual one and two impulses.

Thus the engine races up and down, and often causes the pressure to vary by quite 5 volts. The governor is well cleaned and well oiled, and works quite easily on the pin. I can find no reason for its so acting.

Thanking you in anticipation of advice on the matter.

Electron.

P.S.—I am an amateur in electricity, but I owe a great part of my present knowledge to your valuable paper, which I have taken for years.

[" Electron " might fit a cap to the bearing of the engine, next to the fly-wheel, say, a piece of tinned iron tubing to act as a splash-board, or, if there is space on the shaft between the wheel and bearing, fix on a ring of brass or iron with a groove so that the oil will be thrown past the edge of the wheel. If the present groove is just in line with the edge of the wheel, the new groove on the ring will be quite beyond it. Gas engines are difficult to govern at varying loads; a fly-wheel on the dynamo often steadies it wonderfully if you can work with a long slack belt. Why not get a gas engine expert to examine your engine? There is possibly a defect in the valves, causing the irregularities you describe.—EDS. ELEC. REV.]

Cardiff Electric Lighting.

We beg to hand you copy of a letter, which we have addressed to the Borough Engineer of Cardiff, and which we think of sufficient general interest to bring under your notice.

Callender's Bitumen Telegraph and Waterproof Company, Limited.

W. LAMBERT, *Secretary.*

101, Leadenhall Street, London, E.C.,
October 16*th*, 1893.

Dear Sir,—We beg to confirm the telegram sent you to-day, as follows:—

" Notice of your Corporation requiring tenders for cables only published in Friday's electrical papers. Tenders required to be sent in to-day, time manifestly too short. Will you grant extension. Please telegraph reply."

And have received your reply:—

" Extension of time for receipt of tenders impossible."

Under these circumstances we desire to lodge a formal protest against the method of inviting tenders which you have adopted, and the totally insufficient time which has been given to independent contractors to make their calculations and to prepare the necessary offers.

We have made enquiries, and find that your Corporation has not advertised in any of the papers devoted to electric lighting, the notice to which reference is made in our telegram to you being taken from the press outside the electric industry.

We call your attention to the fact that this is the first contract for electric cables "advertised" by a Corporation which has not been fully announced in the trade journals.

The method you have adopted in inviting tenders precludes open tendering by independent manufacturers.

If your Corporation had decided to invite certain makers to a private competition we would have had nothing to say, but we distinctly protest against action, such as has been adopted in the case of Cardiff, being considered as a public invitation to tender. We reserve to ourselves the right to make this letter public.

CALLENDER'S BITUMEN TELEGRAPH AND WATERPROOF COMPANY, LIMITED.
T. O. CALLENDER, *Manager.*

W. Harpur, Esq., Borough Engineer,
Town Hall, Cardiff.

What is Lithanode?

Apropos of the note under this heading in your last issue, will you allow me to call attention to the view expressed by Sir David Salomons in the fourth edition of his work "On the Management of Accumulators," page 20. This is as follows:—

"There is yet another kind of positive plate which deserves our attention . . . . It is made of solid peroxide without a leaden support, and, in its present form, Mr. FitzGerald may be regarded as the inventor. He gives the material the name of lithanode; but there is not the slightest reason for calling this well-known substance by a new name." The same statement, which has considerably puzzled others as well as myself, is repeated in the sixth, and, I believe, in other editions of the work in question. It would appear to imply that there is a doubt as to my being the sole inventor of "lithanode," and that, in fact, the substance was "well-known" before the "new name" was given to it.

Personally, the matter is of little interest to me, which will account for my not having noticed it hitherto. But, in the interest of scientific accuracy and historical truth, Sir David may consider it desirable to elucidate his view. I have written to request him kindly to do so.

For some obscure reason, the notion has been extensively prevalent that lithanode is "made of" peroxide of lead, or that it is "compressed peroxide of lead." Your note may aid in removing this misconception.

I may mention that I have only recently succeeded in overcoming some serious practical shortcomings of the older processes of manufacturing this material. For instance, somewhat over a year ago, Mr. W. Moscrop reported to me that the "forming" of the lithanode, manufactured under his supervision, occupied 14 days of 24 hours, of which 7 days were occupied in charging. At the present moment, the maximum period occupied in "forming" is 48 hours.

Desmond G. FitzGerald.

October 17*th*, 1893.

Re Incandescent Lamps.

Regarding the letter in last week's issue on the above subject from the General Electric Company, Mr. Edison, in his interview with the enterprising German gentleman who directs the affairs of the General Electric Company, omitted to say that beyond the few agreements he has with the English Edison Company, there is a little matter of £117,000 worth of B shares which he and his friends hold between them. A dividend has been paid on these shares, and it is difficult therefore to understand how Mr. Edison came to say that he has heard nothing for many years past from the English company.

Electric lighting firms in England have, as is well known, received very scant treatment indeed in the past from the Edison & Swan Company in the matter of trade discounts, and it is all the more remarkable therefore that there should be, as there undoubtedly is, a friendly disposition on the part of the leading firms to continue the use of the Edison and Swan lamps as before, rather than fall back on German importations or lamps made by a German house in England, even if a slightly higher price has to be paid for what is commonly believed to be the superior article.

English manufacturers have hitherto been able to supply the needs of English electric lighting firms, and it is sincerely to be hoped that an effort will be made to keep the lamp business in English hands and prevent the trade going to the Continent. That Continental lamp manufacturers intend having a good try for English business is evident from your advertising columns.

For the present, at any rate, the only lamp the Edison and Swan Company has to fear is that made by the Swan United Company, its own sister.

While a number of the lamps used by the latter company are made at Ponder's End, the rest are manufactured at the Continental works, and the lamps are as much alike in appearance and behaviour as two peas.

The two companies are under the same management, and, to all intents and purposes are, or shortly will be, one and the same, and it will be interesting to see whether the lamp made by the company at its Continental works will be sold in England at the same price as it is abroad.

G.

NOTES.

Electrical Fog Signalling.—The Great Northern Railway company are this week extending on their North London branches the experiment of fog-signalling by means of electricity, which will, it is hoped, in time entirely supersede the explosive caps as at present used on the whole of the British railways.

Electro-Tanning.—Mr. L. A. Groth has removed from his London address, No. 3, Tokenhouse Buildings, E.C., to Orbe près Lausanne, Switzerland, where he has taken the technical management of the largest tannery there, which is now being enlarged and entirely reconstructed according to "Groth's system" of tanning by aid of electricity.

Glasgow and West of Scotland Technical College.—The syllabus of lectures to be delivered before the Scientific Society of the above college during the 1893-4 session includes several on electrical subjects, *i.e.*, December 9th, "Sir William Siemens and His Work," by Mr. James, Riley; January 13th, 1894, "Electric Power Transmission," by Mr. H. A. Mavor; February 10th, "The Ether and Electricity: Their Connection," by Mr. James Blyth, M.A., F.R.S.E.; "Some Steam Engine Problems," by Mr. John Anderson, on November 11th, 1893.

The New Caledonia Cable.—The following telegrams, dated 16th inst., are on the Queensland—New Caledonia Cable:—"Brisbane. The Société Française des Télégraphes Sousmarins under contract with the Governments of France, Queensland, and New South Wales, which have guaranteed a subsidy of £12,000 a year, has just completed the laying of a submarine cable between New Caledonia and Queensland."

"Sydney. Sir George Dibbs, the Premier of New South Wales, in the course of an interview, defended the construction of the Queensland New Caledonia Cable, declaring that it would be useful in many ways, and especially in the event of war in the South Seas. He agreed that it was necessary that the Pacific cable of the future should be under British control, but insisted that New South Wales was still at liberty to co-operate in any such undertaking. He considered that the construction of the cable to New Caledonia should show the British Government the necessity of laying a cable across the Pacific *viâ* New Zealand, Fiji, Samoa, and Honolulu."

A telegram from Melbourne, dated 15th inst., states that the Marquis of Ripon, in reply to the letter addressed to him on the subject by the Hon. J. B. Patterson, Premier of Victoria, expresses his regret at the action of Queensland and New South Wales in committing themselves to the laying of a cable to New Caledonia to serve as the first section of the proposed British cable across the Pacific to North America. The Secretary of State points out that this action is at variance with the views expressed by the Colonial Conference held in 1887, and lessens the chances of those colonies which are assisting in the scheme of laying an entirely British Pacific cable. He concludes by stating that he shares the opinion of the Victorian Government that a French section in the Pacific cable might become a source of danger to Imperial and Colonial interests in time of war.

A correspondent of the *Times*, in a letter regarding this subject, says: "Is it not something in the nature of a national humiliation that the first section of a cable from Australia to America—Queensland to New Caledonia—should have been just completed by a French company subsidised by the French Government and the Governments of two of our own colonies, New South Wales and Queensland. . . . . Sir George Dibbs hopes that the construction of this foreign cable will stir up the Imperial Parliament to the necessity of establishing without further delay a new cable service across the Pacific entirely under British control. But will it? I believe that we shall one day have to pay dearly for our apathy in this important matter, that the time will come when overpowering reasons of Imperial policy will compel us to acquire this foreign cable service at a price that will be enormous in comparison with what it would have cost to construct a Pacific cable at our own expense during the years that we have been idle while our foreign competitors have been at work."

Barrow Electric Lighting.—A provisional order will be applied for very shortly.

Lambeth and Electric Lighting.—A correspondent writes to us as follows:—"Though, as a Lambeth ratepayer, I had nothing to do with the resolution classing the electric light as unnecessary and extravagant, yet I cordially approve of their action. We want the electric light badly, for our gas is of the worst; but, as we unfortunate ratepayers in Lambeth have strong opinions as to where and into whose pockets goes the bulk of our heavy rates, we are naturally anxious that the Lambeth Vestry should not have the farming of the new light. . . . . The gas is as impure as the water, and there is no health in us. Therefore, we do not want the electric light to fall into similar evil hands, and would rather wait till vestries are no more."

Electric Lighting and Motive Power in the New Sorbonne, Paris.—Nearly all the old Sorbonne has been pulled down; the greater part of it is rebuilt, and the rest is now in course of reconstruction. The new buildings will be lighted by electricity. A contract for the maintenance of 200 16-candle lamps has been signed by the architect and by M. Naze, the director of the Secteur de la Rive Gauche. A distribution of motive power will also be effected by means of electric motors installed in the various laboratories used for instruction. It would be difficult to say precisely when this system will be in working order. The lighting of the Secteur de la Rive Gauche has been talked of for some time, but nothing has been done as yet.

Constantinople and Electric Lighting.—We cull the following from *Money and Trade*:—"Beyond question, the most important matter in electrical engineering circles during the week has been the publication of the daring project to light Constantinople by electricity generated by ocean currents. The author of this delightful idea is an ingenious Greek, who proposes to illuminate Stamboul and the Bosphorus, from Cavak as far as San Stephano. The scheme is considered feasible, and a company of capitalists has been formed to carry it out, an application for a concession being at the same time addressed to the Turkish Government. The inventor suggests the erection of three very powerful dynamo machines, to be placed upon the three points of the Bosphorus where the current from the Black Sea to the Mediterranean has the greatest force, and the Sultan has appointed a commission to report details. Hitherto the harnessing of Niagara for industrial purposes has been the greatest thing accomplished in the electrical line, but if the Mistress City of the East is in future to be lighted up by aid of marine current, the Americans will have to lower their laurels. The peculiar situation of ancient Byzantium naturally lends itself to such a project as that now proposed. But what applies to Constantinople would not apply to other cities by the sea."

Taxation of Machinery.—The prolonged contest at Chesterfield over the rating of machinery is at last concluded. Messrs. Hewitt, Bunting & Co. were not satisfied with the reduction offered by the Assessment Committee, from £460 gross (Mr. Hedley's valuation) to £168, and therefore gave notice of appeal to Sessions. Acting under the advice of Mr. Humphreys-Davies, who, as surveyor to the Machinery Users' Association, has been conducting all the appeals, a compromise was offered, in order to avoid further expensive litigation. This was accepted by the Board of Guardians, and the result is that the assessment is further reduced to £126. The total figures of the nine manufacturing firms and companies who acted together show the unwarrantable nature of the attack on machinery, and how signally it has failed in this instance. The old rateable value of these firms was £8,036. Messrs. Hedley, Mason & Hedley, in their re-valuation on behalf of the Union, increased this by £7,382. The Assessment Committee, on hearing the objections, reduced this increase by £6,062, and on appeal to Sessions, a further £620 was knocked off, the net result being an increase of £700 in the aggregate assessments of the nine appellants. Thus only 10 per cent. of the increase was finally sustained. These figures show conclusively how machinery users can, by combination, defeat the efforts to tax the productive power of the country.

Electric Lighting at Hertford.—The Corporation have decided to postpone the further consideration of the proposed electric lighting scheme for the town until next year.

Chester Electric Lighting.—On 11th inst. the Chester Town Council decided to adopt the Hop Pole Paddock as a site for an electric lighting station for the city. The paddock is on one side of the Chester walls and the cathedral on the other. Several of the cathedral dignitaries, including a Dean, a Canon, and an Archdeacon, attended and pointed out "the inconvenience that would possibly result, the danger from vibration, and the injury to the appearance of the Cathedral and walls." This remonstrance appears to have had but little effect upon the minds of the Councillors.

Leeds Electrical Tramways.—At a meeting of the members of the Highways Committee of the Leeds Corporation, held on Thursday last week, it was decided to renew the lease of the Thomson-Houston Company over the electric tramways to Roundhay Park for six months, and after that for an ensuing period of one month at a time, until some final arrangement was arrived at. Last Friday a deputation from the Highways Committee visited South Staffordshire to inspect the single overhead electric wire system of tramway traction.

Storm in the United States.—As a result of the great storm which visited the United States late on Friday night last, the Western Union Telegraph Company have no wire standing between New York and Philadelphia or New York and Washington.

The storm played great havoc at Baltimore. Two electric light wires in that city became crossed in the tower of the Brush Electric Light Works, setting fire to the tower. Pieces of blazing wood were blown to the rafters of the gaol near by, where 544 prisoners were confined, and the building was burned down. The prisoners were rescued with difficulty, one man being killed and 20 injured. The loss of the electric company amounts to $200,000, and the burning of the gaol entails a loss of $55,000.

Newport Electric Lighing.—Application is to be made to the Local Government Board for sanction to borrow £28,000, repayable in 30 years, for the purpose of providing a supply of electricity in the borough. A preliminary report of Mr. Robert Hammond upon the proposed installation has been received. The estimated expenditure, including the mains and arc lighting of the installation for the western district of the borough is £25,000. The report has been considered by the sub-committee, and some modifications in the proposals suggested. In the meantime the sub-committee have been authorised to request Mr. Hammond to proceed with the preparation of the detailed plans and specifications, in order that tenders may be obtained at the earliest possible date.

Wayside Ambition.

(*With apologies to the "Chicago Record."*)

I want to be an 'lectrician,
Hot stuff!
Rubbin' up dinnymos and 'ingynes bright,
Pumpin' juice inter wires to make light,
Turnin' a wrench to make things tight—
That's what an 'lectrician does.

I want to be an 'lectrician,
Gee whiz!
Makin' the boys keep outside the station,
Cussin' the firemen like tarnation,
One o' the big bugs o' creation—
That's an 'lectrician, I tell ye!

I want to be an 'lectrician,
By gum!
Runnin' wires fer bells an' calls,
Settin' machines with blocks an' falls,
Prancin' round in check overhauls—
There's an 'lectrician fer ye!

I want to be an 'lectrician,
Dog gone!
Inventin' lamps an' cut-out switches,
Makin' kinks an' new half-hitches,
Lot's o' money in my breeches—
I'll be one, some day, too!

VOLTABOUT

(In the New York *Electrical Review*).

Plymouth Electric Lighting.—The Town Council intend applying for a provisional order. The present lighting by gas costs about £3,800 per annum.

The Institution of Electrical Engineers.—The annual dinner of the Institution is fixed to take place at the Freemason's Tavern, Great Queen Street, on Wednesday, November 22nd.

Bradford Scientific Association.—At the last meeting of the Bradford Scientific Association the presidential address was delivered by Mr. J. T. Riley, D.Sc., on "Central Station Systems of Electric Lighting."

Ealing Electric Lighting.—The Ealing Trades Council have asked the Local Board to receive a deputation from them on the subject of wages of workmen employed by the contractor for the provision of electric light in the district. It has been resolved to receive the deputation at the next meeting of the Board.

Coast Communication.—Instructions have been given for the immediate laying of cables between the shore and the Kentish Knock and North Goodwin Sands Lightships for telephonic communication, so that the work may be done before the winter sets in. The cable to the North Sands is to be landed at Dumpton Gap, Ramsgate, and the cable for the Kentish Knock at Kingsgate Bay.

Engineering Side-Lights. — About three weeks ago *Industries* gave a portrait of Mr. Hirst, of the General Electric Company, together with a description of a very funny interview, apparently written by one of *Pearson's Weekly* young men. In to-day's issue, which came out yesterday, there is a lovely picture of Mr. Binswanger, who has also been interviewed. But why should our *Iron-Industries* contemporary ironically term Messrs. Hirst and Binswanger "Engineering side-lights"? We congratulate Mr. Binswanger on his new cookery school, "including two profoundly attentive damsels."

The Harness Electropathic Belt.—We are anxious to call our readers' attention to a series of articles on the Harness electropathic business, which is appearing in the *Pall Mall Gazette*. The first article, which appeared yesterday, is one of the fiercest attacks ever made in the English press upon an individual. Much of the evidence which was suppressed in the recent action is served up, and we imagine the British public will have its eyes at last opened to this imposition.

Important Litigation in Germany.—A telegram from Frankfort-on-Main, dated 18th inst., states that judgment was pronounced against the plaintiffs in the action brought by the London Electrical Power Storage Company against the Pollak Company, the proprietors of the accumulator works in this city, to restrain the latter from manufacturing or selling accumulators. This is the first time that a German court of law has given a different decision from that pronounced in similar actions against other accumulator manufacturers preferred by the actual patentee, namely, the Accumulator Manufacturing Company of Hagen.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Chili Telephone Company, Limited.—This company has lately filed its annual return, which shows that out of 50,000 £5 shares, 44,000 have been taken up and fully paid.

Hobart Tramway Company, Limited.—The name of this company has been lately changed to the Hobart Electric Tramway Company, Limited.

Canterbury Electricity Supply Company, Limited.—A notice lately filed at Somerset House shows that this undertaking has been dissolved by notice in the *London Gazette*.

Cardiff Electricity Supply Company, Limited.—This company has been dissolved under clause 7 (4) of the Companies' Act, 1880 (43 Vict., c. 19), by notice in the *London Gazette*, dated August 13th, 1893.

Chelmsford Electric Lighting Company, Limited.—From the latest filed return of this company, it appears that out of a nominal capital of £10,000 in £1 shares, 5,507 preference shares have been taken up, with the full amount called on each. The sum realised reaches £5,500, leaving £7 still to be paid.

Bickle & Co., Limited.—This company has lately filed its yearly return. The nominal capital is £50,000 divided into £10 shares, of which 2,021 have been taken up, and 1,000 issued as fully paid. The full amount has been called upon the remaining 1,021 shares, which has resulted in an aggregate payment of £10,050. There is £160 still unpaid.

Corlett Electrical Engineering Company, Limited.—The last annual return of this company shows that out of a nominal capital of £10,000 in £10 shares, 620 shares have been taken up. A sum of £7 has been called on 520 of these, which has realised £3,640. An amount of £1,000 has been agreed to be considered as paid on 100 shares.

Railway Automatic Electric Light Syndicate, Limited.—The registered office of this company is now at 37, Walbrook, E.C.

CONTRACTS OPEN AND CLOSED.

OPEN.

Sunderland.—November 3rd. Tenders for electric lighting plant for the Corporation. Full particulars will be found among our advertisements.

CLOSED.

Taunton.—The Town Council have accepted the following tenders:—An additional boiler from Messrs. Davey, Paxman and Co., at a cost of £380; a steam drum from Messrs. Babcock, Willcox, at a cost of £30.

BUSINESS NOTICES, &c.

The Universal Electrical Directory (J. A. Berly's), now under the direct supervision of the proprietors, H. Alabaster, Gatehouse & Co., is in active preparation for the 1894 edition (12th year). This is a directory of the electrical trades embracing the whole Universe, and having no superfluous matter irrelevant to a directory it can be sent everywhere, carriage paid, for 4s. It is indispensable to all having business transactions in the electrical world, and once used cannot be done without. Advertise in it! Order it! It will prove the best outlay ever made.

St. Pancras Electric Lighting.—With reference to the extension of the Regent's Park central station, the committee advertised for tenders for the buildings, and in response have received 12 tenders for same, that of Messrs. E. Houghton & Son, of Stroud Green, for £1,875 4s., being the lowest. The committee recommended a contract be entered into accordingly with Messrs. E. Houghton and Son. With reference to the extension of arc lamps to the Brecknock and Camden Roads, the committee received a certificate from Prof. Robinson that the retension money due to Messrs. Johnson and Phillips in respect of these lamps may now be paid; but it was felt that the charge of £7 7s. per week made for the trimming of the lamps was excessive. Negotiations have for some months been proceeding with a view to a settlement of their accounts for this work, and Prof. Robinson reported that Messrs. Johnson & Phillips are now willing to accept a sum of £5 5s. per week to effect a settlement, although this sum will not meet the expense they have been put to in the matter. The committee had very fully considered the matter, and in view of the long period during which it has been in abeyance, and the desirability of a final settlement being arrived at, have come to the conclusion that an offer of £500 should be made in full discharge of all claims in respect of these lamps and attendance. The committee had also given instructions for the trimming to be done by the Vestry's servants, and this work will now be carried out under the supervision of Mr. Baron. They therefore recommended that a cheque for £500 be drawn in favour of Messrs. Johnson and Phillips in full settlement of all outstanding claims for extras and otherwise under their contract, and their charges for trimming the arc lamps. At the meeting of the St. Pancras Vestry the other day, Mr. Gibb stated that Messrs. Johnson & Phillips had refused to accept the £500 as a settlement and the recommendation was therefore withdrawn.

Southend and Electric Lighting.—The Town Council have empowered the Highways and Works Committee to invite offers to undertake and carry out the powers vested in the Corporation under the Electric Lighting Order, special regard being had to the system of lighting, the maximum charges to consumers, and the time for which any contract for the purpose of deed of transfer should run.

Electric Lamp Pillars.—In connection with the electrical fête at Blackpool, it is interesting to note that Messrs. George Smith & Co., of the Sun Foundry, Glasgow and London, who designed and manufactured the beautiful pillars on the Blackpool Promenade, which we illustrate, are gaining a unique position amongst iron-founders in the electrical world, as far as concerns ornamental

pillars for arc lighting; and they have already supplied and erected the artistic columns to be found in the streets of the following cities and towns: City of London, St. Pancras, King's Cross Railway Station, Blackpool, Dublin, Dundee, Huddersfield, Londonderry, &c., besides some contracts now in progress. The above firm have just issued a new illustrated catalogue of electric castings, copies of which can be had free on application. The book, which has been splendidly got up, contains many large illustrations of various styles of lamp pillars, along with information as to the sizes of the same. Electric lamp brackets; patent retracting electric light ladders; and electric gutters and connections are also described.

The 107th Installation.—The offices of Messrs. Rashleigh Phipps & Co., 102, Oxford Street, were the scene of a very interesting ceremony on the 13th inst., when the whole of the employés assembled for the purpose of making a presentation to Mr. Phipps (rashly importunate) on the occasion of his wedding. The gift consisted of a handsome marble clock, and was accompanied by an illuminated address. On Wednesday, the 18th, the whole of the employés were entertained at an excellent dinner at the Bedford Head Hotel. The firm is extremely busy, having a great deal of work in hand at the present moment, and have carried out in all, since Mr. Rashleigh Phipps dissolved partnership in November last, 106 installations, varying from 50 to 500 lights.

Electric Lighting at Bradford.—At a meeting of the Gas and Electricity Supply Committee of the Bradford Town Council, last week, the desirability of lowering the charges for electricity used for motors during the daytime was discussed. A reduction of 3d. per unit was suggested, but it was stated that there was some difficulty in carrying out such a proposal owing to the want of a satisfactory meter. The committee appeared to be favourably disposed to the change, and a sub-committee was appointed to inquire into the subject.

Catalogues, Lists, &c.—Messrs. Siemens Bros. & Co., Limited, have just published a new price list (No. 3A, D.) of their dynamos. The first few pages contain some very fine illustrations showing a Siemens dynamo, a central station set (Siemens dynamo and Willans engine); ship lighting set (Siemens dynamo and Tangye engine), as supplied to P. and O. steamers; ship lighting set (Siemens dynamo and Browett-Lindley engine); ship lighting set (Siemens' dynamo and Belliss engine), as supplied for ss. *Campania* and *Lucania*. There follow these illustrations three tables in which are set forth the outputs of dynamos at 66 volts, the number of revolutions per minute, and the number of kilowatts, as well as the maximum load in 60-watt lamps at maximum speed are here given, while more detailed reference is made to the various types mentioned, farther on in the book, where are arranged in a very convenient and ready manner all particulars regarding the prices of the various parts of the machine, packing, weights, dimensions, &c. Messrs. Siemens must have expended a great deal of time in setting forth the information in such straightforward style for the assistance of their customers and the trade generally. At the end of the pamphlet is a short telegraph code. The book, which consists of 32 pages, is nicely printed on good paper.

Messrs. Baker & Co., Railroad Avenue, Newark, N.J., have forwarded us a pamphlet containing data concerning platinum, &c.

Electric Lighting at Halifax.—Last week a meeting of users of the electric light was held at the Mechanics' Institute. The present company who provide the electric light will cease to do so after November 18th. It was decided to approach the Electric Lighting Sub-committee of the Corporation, and to submit to them a resolution requesting the Corporation to come to some arrangement whereby the power for supplying the light may be continued until the proposed works of the Corporation are ready. They believe it would be to the interest of all parties if the present users could be retained as customers. The deputation afterwards waited on the Committee of the Corporation.

A letter has been sent to the Halifax Corporation by Mr. T. England, solicitor, on behalf of the Halifax Mutual Electric Light and Power Company, stating that the Company would in consideration of the Corporation paying them £2,000, guarantee to continue the light for twelve months; or, as an alternative, offer that the Company would accept £4,000 for the plant, the Corporation taking over the same at once. A sub-committee appointed by the Gasworks Committee to consider the offers has recommended that neither be accepted. The offer of Mr. W. H. D. Horsfall, architect, to prepare plans, &c., for the proposed electric light works has been accepted.

Electric Light at Wakefield.—Messrs. Hall & Armitage, house furnishers, &c., of New Wells and Westgate, have had their establishment fitted up with the electric light. Along the Charlotte Street side, Swan-Edison incandescent lamps of 16-candle power are fitted, but the special display is in the main front to Thornhill Street. On the outside, over the tops of the windows are two large lamps of 300-candle power each. The shop windows are each lit with an electrolier of four lights. In the office there are five 32-candle power lamps. There are thirty-one show rooms in all, and each has its complement of lamps. The engine that has been laid down for this purpose is one of Crossley's "Otto" silent gas engines, which drives a dynamo put down, along with all the other fittings, by Messrs. J. G. Statter & Co. The dynamo lights 150 lamps. A 60-candle power illuminates the wood yard, and the workshops are full of smaller lights.

Lynton Electric Lighting.—Mr. Benn has made an offer of his electric lighting undertaking to the board. The board have been already paying £93 for lights at present in use, and if the additional lights asked for were put on it would amount to £143. Provided the board would add £50, making £193 in the whole as an annual rental, he would hand over the works and undertaking. He made this low tender as he was desirous of accepting a large American order. He estimated the working expenses would be about £250. Besides what the board was paying him, there was a revenue from private consumers of about £400. He also stated that after the lapse of 42 years the undertaking would come absolutely free to the board. It was resolved that a public meeting of ratepayers be called to consider the advisability of acquiring the electric light works.

Chelsea Town Hall Lighting.—The Electric Lighting Committee have reported to the vestry that they had adjourned the further consideration of the letter from Mr. T. Fidge, dated July 11th, reminding the Vestry that the London Electric Supply Corporation are about to extend their mains up the King's Road, stating that their charges are considerably lower than those of the company at present supplying the district, asking whether the Vestry would care to introduce the electric light into their premises, and stating further that in view of the recent reductions in charge, electric light has become as cheap as gas. The Committee recommended that the Hall Committee and the Electric Lighting Committee combined be requested to again consider and report as to the advisability of lighting the Town Hall with electricity. The proposition was adopted.

Bankruptcy.—Mrs. Selina Philipina Rowbottom, carrying on the business of an electrical engineer in Abbey Street, Derby, on 13th inst., came up for her public examination at Derby. She said that her husband was adjudicated a bankrupt in 1889. Immediately afterwards she commenced business in her own name with no capital. She found she was insolvent in September last. Since then she had contracted no debts, but goods ordered some time previously arrived at her business place. The day after the goods were ordered a creditor, to whom she owed £25 9s. 3d., seized her goods. She had given a bill of sale for £55 to a dealer in electrical appliances. He promised that if she would do this he would supply her with more goods, but he had not done so. The examination was adjourned.

Electric Lighting at Dover.—Messrs. Chitty, of the Charlton Flour Mills, Dover, have, this week, had the whole of their premises lit by electricity, there being 126 incandescent lights of 16-candle power, with two outside lights of 60-candle power, and the dynamo is driven by water power obtained from the river Dour by means of a water-wheel. On the various floors of the mill are hand lamps which are highly satisfactory. The work of installing the light was entrusted to Messrs. Christy Bros., of Chelmsford, under the superintendence of Mr. C. E. Smith. Several other mills and other large firms have made enquiries for the light now that one firm has led the way.

A Private Installation.—Mr. John Wilson, of 211 and 213, Stamford Street, Ashton-under-Lyne, has had his clothing establishment lighted by electricity. The dynamo is driven by a gas engine, supplied by the National Gas Engine Company. In the doorway is a splendid 100 C.P. incandescent light, and in one window there are 12 32-C.P. lamps and the other seven lamps. In the centre of the shop there are about a dozen lamps, and about the same number in the ready-made department. There are also about six lights in the hat shop, and more than a score of them in the cutting and various rooms upstairs.

Personal.—Mr. Hylton Spagnoletti is severing his connection with the National Telephone Company, after eight years' successful management of the Swansea branch of the late Western Counties and South Wales Telephone Company. Messrs. J. B. Saunders & Co., of Cardiff, have secured Mr. Spagnoletti's services as their agent in Swansea and district for electric light installations and private telephone work in all its branches.

We understand that Mr. Joseph A. Jeckell, late works manager of the International Okonite Company, has been appointed electrical engineer to the Borough of South Shields.

Bad Navigation on the Thames.—At Kingston-on-Thames last week, Mr. John Hill, of the General Electric Power and Traction Company, Limited, Platt's Eyot, Hampton, was summoned for having, on July 15th, navigated the electric launch Flosshild, off Platt's Eyot, on the Thames, on the occasion of Molesey Amateur Regatta, so as to obstruct and impede and interfere with a certain pair-oared race, contrary to the bye-laws of the Thames Conservancy. The magistrates having retired to consider, the chairman said it was a difficult case, but they had decided to fine the defendant 5s., and to order him to pay costs amounting to £2 0s. 6d.

Electric Lighting in Germany.—The Frankfort-on-Main Town Council has adopted the proposal of the Executive Department for the erection of municipal electric light works, according to the plans submitted by Messrs. Miller & Lindley, on the alternating system with transformers, and a low tension distributing network. The *Financial Times* says that Messrs. Brown & Boveri, of Baden, have been entrusted with the construction of the electrical engines, and Messrs. Felten & Guilleaume, of Cologne, with the supply of the cables.

Douglas defers Consideration.—The minutes of the Health Committee, read at the last meeting of the Town Commission, included the following: "Read letter from Mr. G. T. Pardoe, Cheetham, Manchester, with regard to the question of electric lighting, and enclosing two approximate estimates of cost for hydraulic electric light stations with steam pumping engines, &c. No. 1, £20,979 5s, No. 2, £20,027 5s." Receipt of the letter was acknowledged, and the matter was indefinitely postponed for consideration.

World's Fair Awards.—The awards to British exhibitors in the World's Fair Electricity Department are announced as follows: British Government Postal Telegraph Department—1. Modern telegraph apparatus in operation. 2. Historical telegraph apparatus. Corporation of Birmingham—Original Woolwich dynamo. General Electric Company, Limited, London—H.I. switches and other incandescent house fittings. James White, Glasgow—Electro-magnetic balances (Kelvin).

Electric Light at Cork.—An electric arc lamp has been erected in one of the public streets. The lamp is used in a limited extent for public lighting, and belongs to Messrs. Robertson, Ledlie, Fergusson & Co., of the Munster Arcade. The Arcade itself is lighted throughout with gas with the exception of two small electric lamps used for window lighting in a portion of the premises stretching back to Old Georges Street.

Mill Lighting.—Messrs. Nicholson & Birkett, of Britannia Corn Mills, Kirton Lindsey, have decided to adopt the electric light throughout the whole of their large premises.

Electric light has been recently introduced into the roller mills of Mr. T. Flowers, at Ramsey, who has also the new illuminant in his house, and a telephone fitted up for communication between the mills and his private residence.

Electric Lighting at Newcastle.—Five electric lamps, each of 1,500 candle-power, have been erected at intervals of 92 feet, in the centre of Grey Street, Newcastle, and will shortly take the place of the public gas lamps in that broad thoroughfare. The Monument is to be flanked with other two electric lamps, and a third will be placed at the Grainger Street end of Market Street to complete the scheme.

Richmond Electric Lighting.—A member of the Town Council recently proposed a resolution to light the main streets of the town with electricity, and a coloured plan, prepared by the surveyor was exhibited, distinguishing the lamps which should remain alight all night, and those which might conveniently be put out after midnight. An amendment adjourning the matter for the present was carried.

The Fowler-Waring Cables Company, Limited.—This company is now represented by Mr. Alfred E. Garbutt in the North of England, Mr. J. Vincent Swindells in Manchester and Midlands district, Mr. Charles Parker in the Eastern and South Eastern districts, including London. Offices will shortly be opened in Newcastle as the centre of the Northern district, and in Manchester as that of the Manchester and Midlands district.

Electric Light Casings.—Mr. W. C. Boulton, late of Messrs. Grover & Grover and Messrs. Vigers Bros. (for a short time), now represents Messrs. Illingworth Ingham & Co., 41 and 43, Great Guildford Street, Southwark, S.E., also of Leeds, Manchester, and Goole. Price list and estimates for every description of casings, &c., may be obtained on application.

Barnet and Electric Lighting.—Not long ago, the chairman of the Local Board received from the manager to the Electric Installation Company, Limited, a letter asking for an opportunity to meet the Board to discuss a scheme for taking over the lighting of the town. The Board have decided to hear what the company have to propose.

Messrs. Smythe & Payne.—This firm have just fitted up a set of offices with over 200 feet of their special electric light tubes for Messrs. Davis and Soper, 6, Great Winchester Street, and also a brass tube with a row of 50 lights in front of the organ gallery at the new Victoria Concert Hall, Langham Place, to light the orchestra. In both cases the insulation resistance was too high to give any deflection on the ohmmeter.

Birkenhead Electric Lighting.—The Electric Lighting Sub-Committee have decided to interview Mr. Shoolbred and Dr. Hopkinson personally, but by many members of the Corporation the question is being raised as to whether it would not for the present be advisable to let the matter rest, or, on the other hand, permit a private company to undertake the work.

St. Pancras Electric Lighting.—A meeting of the West St. Pancras Ratepayers Association was held last week when the following resolution was passed:—"That this meeting, while heartily approving of the electric light, desires to impress upon the Vestry the necessity of improving the public electric lighting in the upper part of Park Street."

Electric Light in Shanghai.—The plant and business of the new Shanghai Electric Company, were acquired by the Shanghai Municipal Council on September 1st last. The electrical department has been placed in charge of Mr. Charles Mayne, the municipal engineer.

Temporary Electric Lighting.—In a recent issue we published some information regarding the arrangements for lighting the Agricultural Hall, Islington, during the three exhibitions, viz., the Brewer's, the Confectioner's, and Stanley's Shows. Messrs. Vaughan & Brown, of 15, 16, & 17, Kirby Street, E.C., are fitting up 50 arc lamps.

Train Electric Lighting.—In consequence of the success attending the working of the electric light on their trains, the directors of the London, Brighton and South Coast Railway have given instructions for ten additional trains to be equipped with it. When these are running, the company will then have 40 trains to which this mode of lighting has been applied.

Explosion.—Last Sunday week an explosion occurred at an inspection box of the London Electric Supply Corporation, in Sloane Square. We hear that the London Electric Supply Corporation were called upon by the Surveyor for a statement as to the cause of the explosion.

Dewsbury Workhouse Electric Lighting.—At a meeting of the Board of Guardians on 13th inst., power was given the Electric Lighting Committee to consult an electrical engineer in respect to the scheme suggested for lighting the new infirmary and the workhouse. The expense proposed is about £2,100.

The St. James's and Pall Mall Electric Light Company, Limited.—The electric current sold by the St. James's and Pall Mall Electric Light Company, Limited, during the quarter ending September 29th last, amounted to £4,820, as against £5,763 for the corresponding period of 1892. Why this retrogression?

Whitehaven Harbour Lighting.—The mains are all laid and everything is ready for the lighting of the harbour excepting the lamp fittings, which for some unaccountable reason have not yet turned up.

Change of Address.—Messrs. Woodhouse & Rawson United, Limited, inform us that, on and after November 11th, the address of their Glasgow branch will be 12, West Campbell Street, where they will have larger and more convenient premises.

The Telephone at Chesterfield.—The Corporation have appointed a committee to meet a director or directors of the National Telephone Company in reference to the notice given the company to remove all the posts in the Borough.

Heywood Electric Lighting.—The Local Government Board have sanctioned the borrowing of £3,000 for a refuse destructor, £3,500 for electric light and machinery for sewage works, as well as sums for other purposes.

Workhouse Electric Lighting.—Messrs. King & Co., of Hull, have secured the contract for installing the electric light in the Hull workhouse, Anlaby Road

Beckenham Electric Lighting.—The Clerk of the Local Board has laid before them the conditions under which the Crystal Palace electric lighting order would be carried out, and these have been approved.

Correction.—With reference to our notice on Glasgow tramways and electricity, Mr. Arnot writes to us stating that the minutes of the council bore that he was to prepare a report on the lighting of the tramcars, not on electric haulage.

Falmouth Electric Lighting.—Messrs. Veale & Co. have presented their report on electric lighting to the Falmouth Authorities.

Nuneaton and Electric Lighting.—The electric light is being tried at Nuneaton by Mr. W. H. Yoxall, confectioner, of Abbey Street.

City Electric Lighting.—Messrs. S. Burnby & Sons have completed the electric light installation of 14 16-C.P. lamps at Mr. Douglas Young's auctioneering offices, 51, Coleman Street, City.

Incandescent Lamps.—On and after November 10th, Messrs. Siemens Bros. & Co. will sell Siemens & Halske glow lamps at 1s. 6d. each.

Steamship Lighting.—The new paddle ferry steamer *Hutton*, launched the other day by Messrs. Wm. Simons & Co., of Renfrew, is provided with a very complete electric light installation.

Paignton and Electric Lighting.—A number of offers have been received from firms for providing an electric light installation. A committee of the Local Board are considering the subject.

Brewery Electric Lighting.—The "Robin Hood" Brewery at Staughton, is being fitted up with the electric light.

CITY NOTES.

Brazilian Submarine Telegraph Company, Limited.

The fortieth ordinary general meeting was held on Wednesday at Winchester House, Sir John Pender in the chair.

In the course of his speech the Chairman said that the receipts in the past half-year were £106,860, as compared with £113,892 in the previous half-year, showing a decrease of over £7,000. As compared with the income of the corresponding half-year of 1892, there was a decrease of £5,010. The receipts for messages showed a decrease of £7,280, whilst their miscellaneous receipts showed an increase of £258. In the half-year under review they carried 3,300 more messages than in the previous half-year, yet the receipts were over £7,000 less. This resulted from two causes—firstly, because of the reduction in the tariff charges from April 1st, and secondly, because of a furthur reduction in the exchange value of the Brazilian silver currency. On the other hand, there was an increase in the receipts from the African coast and Cape Colony. The total expenditure for the half-year was £40,580 which, compared with the previous six months, showed an increase of £16,044, resulting from quite an exceptional state of things due to the necessity for having several repairs and alterations made to the cables. Notwithstanding all the difficulties they had had to encounter, they were enabled to declare the same dividend as formerly, although they had not added to the reserve fund in the same degree as before. It was true that they had at the present time to face a revolution in the Brazils, and that they had had to encounter something very similar in the Argentine. But it was very curious that revolutions, which disturbed business people generally, somehow or other had to find voice in the submarine telegraph, and the consequence was that if times were very good, the Submarine benefited, while if times were very bad they did not benefit to quite the same extent; but, still, they did not die out. It was true, also, that they were conducting a monopoly, but it was a monopoly conducted on broad and generous principles. He then formally moved the adoption of the report and accounts, and the declaration of dividends and bonus as mentioned in the report.

Mr. F. Youle seconded the motion, which was put and unanimously agreed to.

The retiring directors and auditors were re-elected and the meeting closed with a vote of thanks to the chairman.

West India and Panama Telegraph.—For the six months ended June 30th last, the directors recommend the full dividend on the preference shares and 1s. per share on the ordinary shares, after having placed £3,000 to reserve.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 15th, 1893, amounted to £949; week ending October 16th, 1892, £902; decrease £53; total receipts for half-year, 1893, £12,111; corresponding period, 1892, £11,755; increase £356.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 13th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £2,941.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.‡	Closing Quotation October 11th.	Closing Quotation, October 18th.	Business done during week ended October 18th, 1893. Highest.	Lowest.
184,500£	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	99 —102	100 —103	...	...
1,134,640£	Anglo-American Telegraph, Limited	Stock	49½— 50½	45 — 47 xd	...	...
2,932,680£	Do. do. 6 p. c. Preferred	Stock	92 — 93	84 — 86 xd	92⅜	85½
2,932,680£	Do. do. Deferred	Stock	9 — 9⅛	8 — 8⅛	9⅛	7⅞
130,000	Brazilian Submarine Telegraph, Limited	10	11⅞— 12⅛	12 — 12⅛	12⅛	12
18,700£	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	1· 0⅛	...
75,000£	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	107 —111	107 —111	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	2⅞— 3	2⅞— 3	3	2⅞
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛— 2⅜	2⅛ — 2⅜	2⅜	2 1/16
125,000£	Do. do. 4½ per cent. Debenture Stock	Stock	107 —109	107 —109	108⅜	...
20,510	Charing Cross & Strand Electricity Supply Nos. 1 to 6, 215 to 718, and 10,001 to 30,000	5	4⅜— 5⅛	4⅜— 5⅛	...	...
44,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	2 — 3	2 — 3	...	...
630,000£	City and South London Railway	Stock	30 — 35	30 — 35	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	11½— 11⅝	11½— 11⅝	11⅝	11 11/16
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	12⅞— 13⅛	12½— 13	13⅛	12⅝
10,000,000$	Commercial Cable, Capital Stock	$100	135 —140	135 —140	138½	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ...	10/-	1/16— 3/16	1/16— 3/16	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	3½— 4½	3½— 4½	...	...
50,000£	Do. do. 5 p. c. 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	96 —101	96 —101	...	...
16,000	Cuba Telegraph, Limited	10	11 — 12	11 — 12	11 1/16	...
6,000	Do. do. 10 p. c. Preference	10	18 — 19	18 — 19	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½— 3½	2½— 3½	...	...
6,000	Do. do. 10 p. c. Preference	5	8½— 9½	8½— 9½	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅜— 12	11⅜— 11⅝xd	11⅝	11 7/16
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	15 — 15½	14⅞— 15½xd	15 3/16	15
70,000	Do. 6 p. c. Preference	10	16 — 16½	16 — 16½xd	16½	16
105,900£	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	109⅝	109¼
1,294,100£	Do. 4 p. c. Mortgage Debenture Stock	Stock	113 —116	114 —117	116	114½
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅛— 15½	15⅛— 15⅜xd	15 7/16	15⅛
62,700£	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	102 —105	102 —105	...	...
222,800£	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	102 —105	102 —105	104	...
320,000£	Do. 4 p. c. Debenture Stock	Stock	112 —115	112 —115	114½	114
108,700£	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	101 —104	101 —104	...	...
146,800£	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	101 —104	101 —104	101½	...
300,000£	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	101 —104	101 —104	103⅜	...
200,000£	Do. 4 p. c. Reg. Mt. Debs. (Mauritius Subsidy) 1 to 8,000	25	104 —107 °/₀	104 —107 °/₀	105⅜	...
49,900	Electric Construction, Limited, Nos. 101 to 45,100	10	1⅜ - 2⅛	1⅜ - 2⅛	...	...
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	⅛— ¼	⅛— ¼	...	...
91,195	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	⅛— ¼	⅛— ¼	...	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	⅛— ⅜	⅛— ⅜	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	¼— 1½	1 — 2	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅜— 9½	9⅜— 9⅝xd	9½	9 1/16
180,042	Do. do. 6 p. c. Preference	10	15⅛— 15½	15⅛ — 15⅝xd	15 7/16	15⅛
150,000	Great Northern Tel. Company of Copenhagen	10	20 — 20½	20 — 20½	20⅜	20⅛
200,000£	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	103 —106	103 —106	104⅜	103⅜
12,134£	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½— 5½	4½— 5½	...	...
9,600£	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6 — 7	6 — 7	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	21½— 22½	21½— 22½	22½	21⅝
200,000£	Do. do. 4½ p. c., Deb., 1896	100	101 —103	101 —103	...	...
17,000	Indo-European Telegraph, Limited	25	39 — 42	40 — 43	41½	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	1 — 2	1 — 2	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4½— 4¾	4½— 4¾	4 15/16	4 13/16
15,000	Do. do. fully paid	5	6 — 6¼	6 — 6¼	6⅜	5⅞
37,500	Liverpool Overhead Railway Ordinary, fully paid	10	5½— 5⅝	5½— 5⅝	8½	4⅜
6,295	Do. do. Pref., £6 paid	10	4 15/16— 4 31/16	6 1/16— 6 3/16	6⅛	...
37,548	London Platino-Brasilian Telegraph, Limited	10	4 — 6	4 — 6	...	...
100,000£	Do. do. do. 6 p. c. Debentures	100	105 —108	105 —108	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6⅞— 7¼	6⅞— 7¼	7 1/16	6 13/16
50,000£	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	104 —107	104 —107	...	...
15,000	Monte Video Telephone Co., Ord., Nos. 1 to 15,000 fully paid ...	5	1½— 2½	1½— 2½	...	...
28,000	Do. do. 6 p. c. Pref., Nos. 1 to 28,000 fully paid	5	3 — 4	3 — 4	...	...
424,597	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜— 4⅞	4⅜— 4⅞	4⅜	4⅜
15,000	Do. 6 p. c. Cum., 1st Preference	10	14 — 15	14 — 15	14⅜	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	13½— 14½	13½— 14½	...	...
119,234	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	5⅛— 5⅜	5⅛— 5⅜	5 3/16	...
726,477£	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	112 —114	112 —114	113½	112½
48,800	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,452	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5 — 6	5 — 6	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	3/16— 5/16	3/16— 5/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 p. c. Guar. Debs., Nos. 1 to 1,000	100	101 —104	101 —104	...	...
11,802	Reuter's Limited	8	5 — 6	5½ — 6½	6½	5⅞
19,980	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	6¼— 6⅝	6¼— 6⅝	...	...
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8½	8 — 8½	8⅜	...
3,381	Submarine Cables Trust	Cert.	116 —121	115 —120	116½	116
78,942	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	2 — 2½	2 — 2½	...	...
37,350	Telegraph Construction and Maintenance, Limited	12	31 — 33	31 — 33	33	31⅜
150,000£	Do do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 —104	...	...
58,000	United River Plate Telephone, Limited	5	2 — 2¼	2 — 2⅜	...	...
146,370£	Do. do. 5 p. c. Debenture Stock ...	Stock	90 —100	90 — 100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	5½— 6½	5½— 6½	...	...
260,900£	Do. do. do. 5 p. c. Debentures	100	98 —101	98 —101	...	...
30,000	West Coast of America Telegraph, Limited	10	2 — 3	2 — 3	...	...
150,000£	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	98 —102	99 —103	...	...
64,242	Western and Brazilian Telegraph, Limited	15	6½— 7	6⅝— 7¼	...	...
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	5⅝— 6¼	5 — 6¼	...	...
33,129	Do. do. do. 5 p. c. Deferred	7½	1¼— 1⅝	1¼— 1⅝	...	...
178,200£	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	103 —106	103 —106	105½	...
222,700£	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 —106	103 —106	105	...
88,321	West India and Panama Telegraph, Limited	10	1⅛— 1⅜	1⅛— 1⅜	1¼	1 3/16
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	10 — 10½	10 — 10½	10⅛	10
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9 — 10	9 —10	...	...
80,000£	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	106 —109	106 —109	...	...
$1,214,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	115 —120	115 —120	...	...
169,000£	Do. do. 6 p. c. Sterling Bonds	100	102 —105	102 —105	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5 — 5⅛	5 — 5⅛	5⅛	5⅛

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Birmingham Electric Supply Company, Ordinary of £5 (fully d), 5—5⅛.—Brush Company, 4½ per cent. Debenture Stock, issued at 1 per cent. premium, 100—103.—Electric Construction Corporation 6 per cent. Debentures, 95—98.—Electric and General Investment, shares of £5 (£1 paid), 1⅜—2⅛.—Founders' shares, 200—225.—Electricity Supply Corporation, Ordinary of £5, 5—5⅛.—House to House Company (£5 paid) 1⅜—2⅛.—Do. 7 per cent. Preference of £5, 5—5⅛.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5⅜—5⅝, 1st Preference Cumulative 6 per cent., £5 (fully paid 6—5⅛.—Manchester, Edison and Swan Company £9 (£1 paid), ⅛—⅜.—Queen Anne's Mansions Lighting and Heating 6 per cent. £100 Debentures, 121—126.

Bank rate of discount, 3 per cent. (October 11th, 1893.)

(I.) ADVANTAGES ATTENDING THE MULTIPLICATION OF ELECTRICAL STUDENTS AND WOULD-BE ELECTRICAL ENGINEERS.

(II.) THE NECESSITY FOR A NEW SUBJECT OF EXAMINATION BY THE CITY AND GUILDS OF LONDON INSTITUTE.

By W. PERREN MAYCOCK, M.I.E.E.

(I.) One of the principal causes of the slow development of electric lighting and power distribution, electric traction, and other applications of electricity too numerous to mention, is the gross ignorance of electrical matters that exists among the general public, and also—though perhaps not to so great an extent—among professional and business men other than actual electrical engineers.

The uses of electricity cannot be forced upon a public; the latter must, to a certain extent, understand and appreciate applications before they will adopt or use them. Thus it should be obvious that everything which tends to spread a knowledge of electricity helps us on in that electrical era in which, notwithstanding the comparative age of telegraphy and electro-metallurgy, we cannot as yet be said to have very far progressed, and the limits of which are practically beyond our vision. In other words, everything that spreads a knowledge of electricity means increased work for electrical engineers.

Unlike many pessimists who think only of present struggles, and not of future reaction and development, I see only good in the multiplication of students and would-be engineers, the extension of electrical literature, and the efforts of writers and lecturers whose aim it is to popularise electrical knowledge; though certainly the latter might occasionally deliver themselves with greater scientific accuracy.

Then, again, it is too often forgotten that there is a necessity for many different classes of workers in our army of electrical progress. The distinguished scientist or professor, the humble teacher of a science class, or the writer of a popular book, have quite as important work before them as the actual engineer. Without the former to make discoveries and suggest applications, our progress would assuredly have been very much slower and less direct than it has been; and failing good teachers and popular writers, many worthy recruits would have taken up some other calling, and much latent talent have been left undiscovered.

I may be pardoned for citing my own case as an illustration of the need of clearly written books, and the difficulties of a beginner some dozen years back. The teacher of the first electricity class that I had the privilege of attending, recommended us as a suitable text-book for beginners, Prof. Fleeming Jenkin's so-called "Elementary Manual of Electricity," than which—with all due deference to the memory of its author—a more discouraging work it would be hard to find; I have it now before me, its margins scored in places to mark certain portions which at the time I despaired of ever thoroughly grasping; and I may safely add that in all probability I should have given up the study in disgust, had it not been for the encouragement afforded by a certain popular shilling book, which, though not perhaps a model of scientific exactness, at any rate emboldened me to persevere in my work.

From my observations as a teacher, I would say to all those who are similarly engaged: "You cannot be too simple in your demonstrations for your beginners. First arouse an interest in the work, leading them over the threshold as it were; and then those who are any good at all will keep to the work for its own sake, if you take care not to advance too quickly for them." By bearing this in mind, I have awakened the interest and energy of many a student who, on first acquaintance, appeared hopelessly dull and stupid. It is from a neglect of this common sense principle that the results in some classes are so unsatisfactory. There are at present at well known technical institutions, certain lecturers and demonstrators who are undeniably clever men as regards the scope of their knowledge, but who are nevertheless very unfitted as teachers. A start is made at the beginning of a session, let us say, with a class of enthusiastic and hopeful students. Speedily, however, the lecturer soars away into higher realms of science and mathematics than are in many cases at all necessary. What is the result? Two-thirds of the class degenerate into non-workers or absentees, a few still keep out their note-books and make entries that they do not understand, while a mere handful will follow the lecturer, and reward his misdirected efforts by scraping through their examination.

The great cry of the pessimists is that the technical institutions are turning out more young men into the various branches of the profession than there is room for. This assertion would be quite true if any considerable number of those who made a start kept to the work altogether. But such is not the case. A good many discover—somewhat late, it is true—that they have no real ability, and consequently take up some other calling—professional or commercial. Others acquire a smattering of applied electricity as a necessary branch of their education, and eventually enter the ranks of civil or mechanical engineers, the army, navy, law, or medicine. In these cases—excepting, perhaps, the second—they cannot be said to enter into active competition with electrical engineers. On the other hand, the service they indirectly render the calling whose ranks they temporarily entered is immeasurable. Every one of them carries the light of electrical knowledge with him, serving to illumine the darkness of ignorance and misapprehension which encumbers all classes of society.

By the above means, by the increase of science and technical classes, the encouragement of popular lectures, and the spread of elementary literature, the public will be gradually taught to appreciate and support the efforts of the electrical engineering profession, with very great mutual advantage.

Taking as a solitary example the adoption of electric lighting in cities and towns, a little consideration should make it clear that had electrical engineers to deal with town councils and corporations less deplorably ignorant of the question which they have to consider, and which they have it in their power to settle immediately one way or the other, and were these worthies egged on by townsmen and public a little more appreciative of the light we offer them, the spread of electric lighting would undeniably have been much more rapid than it has.

From the various conclusions arrived at above, it seems clear that the issue of elementary and popular books should be encouraged, always providing they are written with reasonable correctness. The statements of those invisible gentlemen — the reviewers — sometimes carry considerable weight with them; and, in justice both to readers and authors, the reviews should be written only after mature consideration. An author writes a book for a certain class of readers, and gives it a certain scope (these two points being generally set forth in the preface); the reviewer takes the book, and more often than not examines it from a wrong standpoint (either it is too elementary, or too advanced, or too popular), quarrels with or praises the binding, arrangement, or style of printing; but he overlooks altogether real errors that require condemnation, or good points which are worthy of notice.

(II.) As every one knows, the City and Guilds of London Institute hold technological examinations in three main branches of applied electricity, viz.: (1) Telegraphy and telephony; (2) Electric lighting and power distribution; and (3) Electro-metallurgy. Now, the so-called *ordinary grade* examination in at least the first two of the above subjects is, in present years, of such difficulty that it is only in very few cases that persons of the artisan class—for whose sake and encouragement these technological examinations were presumably principally instituted—obtain certificates; the majority of the successful examinees being students and embryo electrical engineers who have had a fairly good education.

We all know the local "electrician," usually a plumber or ironmonger who dabbles in electric bell and telephone fitting, and whose woefully bad work has probably done more than anything else to retard the due appreciation by the public of the many household signalling and other appliances which can be worked by primary batteries. Just as we have our registered plumbers, why should we not have men who—after examination—could claim to be "*certificated for household electrical fitting*;" or some such title as "*registered electric signal fitter*;" "*registered electric fitter*;" "*registered*

house electrician?" Of course, the use of the term electrician or electrical engineer *per se* would not be admissible. Such a man would want to know a little about simple telephones and telegraphs, and also electric light fitting, in addition to ordinary bell, indicator, and alarm work; and it is clear that neither of the above examinations cover the necessary ground. Supposing such a man desired to test his knowledge of, say, telephone and telegraph fitting, and sat for the examination in telegraphy and telephony; he would, as has been before pointed out, find that the examination paper was far and away beyond both his capabilities and his requirements.

For the last four or five years I have held a class in Croydon, especially intended for "local electricians," the syllabus for which, as arranged by me, and extracted from last session's "*Programme*" of the Croydon County Polytechnic, is as follows:—

Class No. 19.

Electrical Engineering Class C.

Electric Telephones, Telegraphs, Bells, Indicators, and Alarms.

(*Lectures and Practical Work alternately.*)

Syllabus.

The construction and fitting-up of Telephone Transmitters and Receivers. The construction and fitting of Needle and Sounder Telegraphs. Magneto, Continuous-action, and ordinary Bells. The Leclanché, Daniell, Fuller, and Bichromate Cells: their construction and charging. Fire, Frost, and Burglar Alarms. Simple and Relay Indicators. The working-out and design of Circuits. Testing for faults in Circuits. The use of the Lineman's Detector. Sounder and ordinary Pushes. Pulls and other contact makers.

Some such syllabus as this, with a few extensions and some additions pertaining to electric light work, would, I beg to suggest, answer admirably as a new subject of instruction and examination under the City and Guilds of London Institute.

At present I am not aware that such a class as that referred to is held at any other of our Polytechnics or evening institutions. Judging from the results of my class at Croydon, I have very little doubt but that great success would attend the establishment of such classes all over the country.

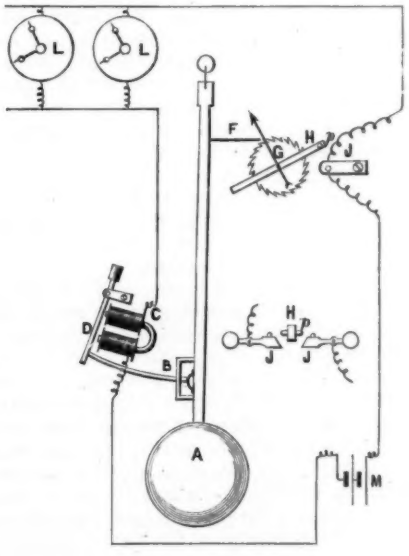
When one considers that nearly every new house now-a-days is fitted with electric bells and indicators, and might also with advantage be fitted with telephones, various kinds of alarms, and many other appliances that at present are very little known or understood by the public, it is time that such work ceased to be ignored by electrical engineers proper, and that workmen should be specially trained for it.

Postscript.—Since writing the above article, I have received the programme of the technological examinations of the City and Guilds of London Institute for the coming session, and I notice that the examiners have at last awakened to the fact that the syllabus of the ordinary grade examination in electric lighting and power distribution is absurdly in advance of the powers of those who present themselves for examination. At least, that is what may be inferred, for, while leaving the ordinary grade syllabus practically unaltered, they have instituted a preliminary elementary examination "with the view of encouraging artisans to take a complete course of instruction in this subject." Those who pass this examination will not, however, be awarded any certificate to confirm the results of their labours, they will merely hear that they have passed. This is surely a mistake, for, though the preliminary examination is intended to encourage artisans to work on for the ordinary grade certificate, it is easy to foresee that the majority will have to content themselves with passing the preliminary stage; for how many, pray, can boast of the knowledge of quadratic equations, trigonometrical quantities, curves, use of slide rule, or logarithms, that is required of ordinary grade candidates.

The syllabus of the preliminary examination states that questions will be set upon—among many other points—"the construction and action of electric bells, the arrangements of battery cells and of circuits for bells, magneto-generators for electric bells." These happen to be a few of the points on which the knowledge of our friend the "local electrician" wants testing, but they are mixed up with "principle and use of electrical measuring instruments; delicate mirror galvanometers; the magnetic drag on wires carrying currents; relations between mass, weight and force; and between heat and work," and other matters of little or no use to him. The fact that the former points are included in the syllabus would seem to show that the examiners see the necessity of testing the candidates knowledge of electric bell fitting, but the subject is only just touched upon. It requires separate and comprehensive treatment as a branch of electro-technical education that has hitherto been neglected.

CAMPICHE'S ELECTRIC REGULATOR CLOCK.

This clock, the invention of M. Henri Campiche (of Geneva) clockmaker of the railway, post and telegraph departments of the Egyptian Government, is one of the simplest arrangements of the kind which has yet been brought out. It consists, generally speaking, of an electrically-propelled pendulum, which may be connected with any number of electrically-driven clocks of the ordinary construction. The arrangement of the pendulum (which constitutes the invention) is shown by the annexed drawing. The pendulum carries at its upper part a spring tongue, F, which at each oscillation turns the wheel, G, one tooth forward; as this wheel has 30 teeth, and the pendulum beats seconds (*i.e.*, makes 60 oscillations per second), the wheel makes one revolution per minute. On the axis of G an insulated arm, H, is fixed; this arm has at one end a platinum pin, *p*. This pin



in the course of the movement of the arm, H, comes between two arms, J, J (see lower fig.), putting these arms in electrical contact, and establishing a circuit from the battery, M, through the electro-magnet, C, and the clocks, L, L. Now, the pendulum, A, in the course of its swing to the left, pushes away the armature, D, from the electro-magnet, C, by means of the rod, B; and if the wheel, G, has been rotated to that position at which the contact pin, *p*, is just ready to pass between and make contact with the arms, J, J, then on the return swing of the pendulum taking place, the wheel, G, is turned still further, and contact is made by *p* a little before the armature, D, comes close up to the cores of C, consequently the latter being excited, the armature, D, is pulled, and gives an impulse to the pendulum through the medium of the rod, B. The end of B acts against the pendulum through the medium of a spring, so as to prevent a sudden

shock being caused by the armature impulse. The continued swing of the pendulum turns the wheel, G, so that the contact pin, *p*, passes through the levers, J, J, thus breaking the contact and allowing the armature, D, to be pushed back when the return swing takes place. The pendulum now goes on vibrating from the impulse given to it until 60 oscillations have taken place, and the wheel, G, is worked round to the position at which the circuit is closed again and a fresh impulse given to the pendulum. Each time the circuit is closed the hands of the clocks, L, are advanced one minute by the usual electro-magnet propelment mechanism.

The whole arrangement, it will be seen, is extremely simple, and well adapted for effecting the object in view.

REVIEWS.

Electric Light Fitting. By J. W. Urquhart. London: Crosby Lockwood and Son.

When a second edition of a book is called for, it may be taken as an indication that the contents of the work are appreciated by a certain section of the public. Mr. Urquhart's work is intended—as he says in his preface—for intelligent men already engaged in the work of electric lighting or training for it. The book is a collection of notes which have been to some extent classified. These notes are said to be the outcome of practical experience, but in one instance, at least, it would appear that the accuracy of the "note" had been taken for granted. Thus, in describing a test for insulation resistance, it is stated that if two lamps be connected in series across the terminals of a dynamo, and the middle wire put to earth, the lamp connected to the terminal on whose line the earth leak exists will become *brighter*. Now, obviously, the above conditions are tantamount to establishing a shunt on the lamp, and it should, and, in fact, in practice *does*, become dimmer. Another questionable suggestion is made in the chapter on wiring of fittings. It is stated that such a fitting as a chandelier may generally be made to serve as a return within itself only. Now, this is altogether a wrong principle, and while permissible, perhaps, under very exceptional circumstances as, for instance, in the case of a chandelier at the top of a theatre or large public hall, or where the chandelier is never touched by hand, still it is diametrically opposed to the principles of sound practice.

The chapter on the incandescent lighting of ships is interesting, but like the whole book is somewhat superficial, that is to say, the subject is not treated as thoroughly as is warranted by so important a subject.

The feature of the second edition of Mr. Urquhart's work is the addition of three new chapters on street cable work, the drawing of specifications, and electric fire risk.

The chapter on street cable work contains descriptions of Siemens, Crompton, Kennedy, Ferranti, and Callender-Webber systems. But the same objections as made above are applicable to the method of treatment of this subject. The descriptions are accurate as far as they go, but they do not go far enough, and the same may be said of the few critical remarks which are occasionally made. Such statements, for instance, as the following are quite inaccurate and exhibit a want of knowledge of the system referred to. "As a general rule feeders to such naked copper mains" (referring to Crompton and Kennedy types) "are of the armoured cable type." Now, this is *sometimes* the case, but, as a rule, a system of mains to supply a demand sufficiently large to justify the choice of one of the above mentioned systems would involve feeders of such a size that they would for convenience and economy be run one on each side of the outer conductor in the culvert.

The chapter on drawing specifications is illusory. Here is a sample. "The dynamos shall show an insulation resistance of — ohms between all parts insulated from each other. They shall be capable of operating at full load for — consecutive hours without increasing the temperature of the armature coils above — degrees Fahr., or of the field magnets above — degrees Fahr.," and so forth. This type of specification is not of much value. It gives no information, and what it suggests is wrong. Obviously the temperature clauses should provide for a maximum rise in temperature above the temperature of the surrounding air. How, for instance, should the blanks of such a specification be filled up in order to suit a dynamo which might have to work—as some dynamos are now working—in a engine room the temperature of which rises at times to 170° Fahrenheit?

The chapter on electric fire risk consists of a reprint of Mr. Musgrave Heaphy's well known rules, and of an excerpt from the rules issued by the Institution of Electrical Engineers.

As giving a great deal of useful elementary information we can recommend the book; but we think the chapter on specifications is out of place, and that a better classification of the information would be a great improvement.

Recent Advances in the Applications of Electricity. By Rinaldo Ferrini, Professor in the Royal Higher Technical Institute of Milan. Second edition; entirely re-written. Second part.—Transformers, Distribution of Motive Energy, Electric Railways, Heating Appliances. With 190 figures inserted in the text. Milan: Ulrico Haepli.

We need not be surprised at the great activity and enterprise displayed in Italy in electrotechnics. That country, like Switzerland, some parts of South Germany, South Eastern France, and Scandinavia, but unlike England, though poor in coal is rich in streams rushing down from the mountains. Till of late this abundant water power has been but scantily utilised. But now by means of electric appliances it is being conveyed to a distance and distributed for industrial uses. One advantage of water-power as compared with coal is only now dawning upon the public mind. The mountain streams are not under the control of trades unions, and the power which they furnish is not liable to be interrupted by strikes or lock-outs. In addition they do not pollute the air with smoke. Hence it may happen that manufactures which depend largely on mechanical power may be to a considerable extent transferred from regions rich in coal to those abounding in waterfalls. Hence, our statesmen, our economists, and manufacturers, might not unprofitably devote some fraction of their thoughts to considering the possible industrial changes which seem impending.

The first part of Prof. Ferrini's work, published in 1892, treated of the dynamo. The part now appearing discusses in the first place transformation by means of accumulators, continuous current transformers, the inconveniences of the Gaulard system, the transformers of Zipernowsky, Swinburne, Siemens, De Ferranti, and Dobrowolsky. In the second chapter we have general studies on transformers, the losses of effect caused by parasitic currents and hysteresis, the influence of the load and of temperature. The third chapter considers direct and indirect distribution, the systems of Edison and Fritsche, the three-wire system with its inconveniences, secondary stations, the system of Siemens and Halske, that of Zipernowsky, the system of Westinghouse, that of Thomson-Houston, of Ferranti, of Kennedy and Dick. Next follow motors of various kinds, those with constant current, alternating motors, synchronous motors, the dynamo-motors of Siemens and Halske, the rotating field, the field with two and three phases, six and twelve phases, with Ferraris and Tesla motors, those of Schulke, of Brown, the polyphase motors of Siemens and Halske. Next follow notices of plants for the distribution of electric energy, the installations of Soletta, of Schaffhausen, Gerzente, Lugano, Tivoli, Lauffen-Frankfort, Heilbronn and Cassel. The advantages of electrical locomotion are summarised as giving ease of working and promptitude of stopping. At Richmond, on an incline of 0·1 per cent., a stoppage or a reversal of movement is effected within half the length of the carriage. The speed which may be obtained varies in general from 10 to 25 kilometres per hour, but it may be carried to 40 kilometres and upwards. It is practicable to overcome sharp curves and slopes up to 32 per cent. The tracks are worn out much less than in steam locomotion. Smoke and sparks are absent. Among the thermic applications are mentioned the furnaces of Siemens and Cowles, and the laboratory furnaces by which Moissan and Violle have lately obtained the most striking results. The work of Prof. Ferrini will be of great value to students of electricity.

Electric Transmission of Mechanical Work with a Description of the Principal Existing Installations, and an Appendix on the Choice of the System of Transmission. With 163 cuts. By Guiseppe Sartori. Milano: Ulrico Haepli.

The electric transmission of power naturally attracts careful study in Italy and Switzerland, as those countries possess water-power in abundance which may be transmitted as required by electrical agency. This being the case, we must not be surprised if they are able to compete at an advantage with countries which are, in this respect, less favourably situate. Norway and Sweden have unlimited water-power, but the severity of the climate greatly interferes with its industrial applications. We, in Britain, can certainly transmit power, but we have poor facilities for its original production. We have no Alps or Appenines to pour down perennial streams to actuate turbines. Hence, pending some capital invention for utilising tidal-power, we are driven back upon the steam engine and ultimately upon coal. How broken a reed this is now to lean upon is well proved by the present paralysis of our industries.

The first part of the book before us contains merely "fundamental notions"—matter generally known and admitted. The second part gives a very full discussion of electro-motors with a continuous current, of those with alternating currents, and those with rotatory magnetic fields. The several modifications of this type of motor are considered successively, *e.g.*, those of Ferraris, of Tesla, of Hutin and Leblanc, Brown and Schückert, as, also, the non-synchronous triple-phase motors of Dobrowolsky and Siemens. The motors of the firm of Ganz, of Buda-Pesth, are prominently noticed, and the remark is added that the firm of Ganz, which has given so powerful an impulse to electric industry, will not stop at the results already obtained, and will, doubtless, persevere in the search for more convenient means to render the alternating current motor a true industrial motor. A self-starting synchronous machine has been already introduced into commerce.

The third part of the work describes the principal installations already existing. Those working with continuous currents are to be found at Genoa, Kriegsstetten and Soletta, "Sciaffusa" (which we believe must signify Schaffhausen), at Gravellona-Toce, Trent and Locle, in Switzerland. Those with alternating and polyphase currents are Cassel, Telluride (Colorado), Intra, Rome, Lauffen-Frankfort, Heilbronn, Baden in Switzerland, Pergine, Romagnano-Sesia, and Palmengarten at Frankfort.

In the Appendix, on the choice of a system, the author is of opinion that when the transfer of power only is required, the triphase system, which has been experimented on at Frankfort, may be safely used. But when light and power have to be jointly produced, it is advisable to have recourse to the Brown system with distinct phases. He reminds us, however, that Tesla's brilliant experiments have given us the prospect of a new system of electric lighting, and suggests that we may, ultimately, have to tell of electric motors as distinct from those now in use.

The electrical engineer will find this volume a valuable work of reference.

Drum Armatures and Commutators. By F. Martin Weymouth. London: The *Electrician* Publishing Company, Limited.

This work makes "much ado about nothing." The drum armature is treated at great length, and to the very smallest and insignificant detail. Eighty-four pages of solid matter are devoted to the drum armature, and in all that we can discover, nothing which has not been put forward by previous writers, and much that could have been conveyed in a sentence spun into pages; and, after all, only one form of drum armature is described, namely, that for bipolar field magnets; the very important class of drum armatures for multipolar dynamos are not touched upon at all.

The winding of armatures is a difficult art to teach by writing alone. Simple diagrams and minute details are here required to make an ordinary wire-winder clearly understand how to carry it out in practice. In this work some diagrams are given, but we are afraid they are not sufficiently simple and clearly explained to enable a winder to follow them. Kapp's tabular system of explaining a winding is not given, so that clear diagrams were all the more necessary.

To students, already somewhat acquainted with drum armatures, the book will be of some interest.

The chapters on commutators are very good, and we do not think this subject has ever before been treated so well and fully; and the causes and cure of sparking at commutators are also very well treated, and will be worthy of the closest study by every student.

The author is much more at home in following out the theoretical points involved in dynamo armature designs, actions, and re-actions, than he is in the description of actual constructions.

The book cannot be called "a *complete* treatise on the theory and construction of drum armatures," although this is claimed for it; but so far as it goes, it will no doubt be of some value to those getting up a knowledge of the details of dynamo machine building.

Engineering Materials. By C. R. Marks, A.M.I.C.E., M.I.M.E. The Technical Publishing Company, Limited.

This is a small work on ordinary engineering materials, iron, steel, copper, and brass. Apprentices and students beginning will find it of some value. The information is correct and the examples of calculations simple and clear. It is a very good eighteenpence-worth of engineering elementary knowledge. It is of handy size for class purposes as a text book.

Numerical Examples in Practical Mechanics and Machine Design. By R. G. Blaine, M.E. New edition. Cassell and Co., Limited.

The author of this book is Senior Demonstrator and Lecturer in the Mechanical Engineering Department of the Finsbury Technical College. The book (which has an introduction by Prof. John Perry) is undoubtedly a most useful one, as it deals with practical questions in a practical manner. The old order of things is gradually passing away, and standard text-books which, a quarter of a century ago, were looked upon with veneration by both teachers and pupils, albeit they were often puzzled to see what bearing the examples given had upon practical work, are gradually being shelved, no doubt to the disgust of the fossil professors who look with some contempt upon the upstart teachers of the present day. Possibly, however, a future generation may have similar remarks to make about the present. To return, however, to the book in question (which is a revised edition), a considerable amount of matter dealing with spiral and other springs, hydraulic and electrical transmission of power, now appears in a form not hitherto published. Problems in thermodynamics and tables of moduli of elasticity, ultimate stresses, strength moduli of sections, &c., completes the bulk of the new matter. Although answers are given to the questions, in many cases it would be an improvement if details of the working out of the same were added, though, perhaps, the size of the book might be unduly increased thereby.

Journal of the Institution of Electrical Engineers, No. 107. London: E. & F. N. Spon, 125, Strand.

The general contents of this number are as follows:—

"On the Prevention and Control of Sparking; Continuous Current Dynamos without Winding on the Field Magnets, and Constant-Pressure Dynamos without Series Winding," by W. B. Sayers. Communications:—"Note on a Detail in Parallel Working of Alternators," by W. M. Mordey; "The Transmission and Distribution of Energy by means of Electricity at Genoa," by Louis Goichot. The question at issue referred to by Mr. Mordey is whether a statement of his that, "two similar alternators similarly excited, driven by separate engines, could be run in parallel, and that, by sufficiently reducing the supply of steam to the engine driving either alternator, the current from that machine could be reduced to zero without alteration of the excitation." Evidence is brought forward from various authorities to prove that in practice the statement is correct.

A B C Five-Figure Logarithms. By C. J. Woodward, B.Sc. London: E. & F. N. Spon, 125, Strand.

It would be difficult to speak too highly of this handy little volume, the principal feature of which is the arrangement of the pages of the same, which are cut away at their margins on the "ready reference" principle, so that a minimum amount of time is occupied in finding any required number. The only fault we have to find with the book is the rather flimsy character of its binding, &c. It would be well worth while to have the pages mounted on linen, and to have the limp binding of a rather better quality, although the price would have to be correspondingly increased; possibly, however, too great a durability is not good for trade?

The Geometrical Properties of the Sphere. By W. Briggs, LL.B., B.A., F.C.S., and T. W. Edmondson, B.A. London: W. B. Clive, University Correspondence College Press, 13, Bookseller's Row, Strand, W.C.

This is a small work of 50 pages, and is a companion volume to the authors' "Mensuration of the Simpler Figures," for the use of students preparing for the Intermediate Examinations in Arts and in Science of the University of London. As a plain exposition of the subject the book is deserving of commendation, but it possesses the fault which so many books have, viz.: a number of examination questions given without any answers to the same; unless a student can be sure that his solution to a question is correct his position is a very unsatisfactory one.

Researches on Stationary Electric Waves. By Dr. Enrico Salvioni, Professor of Experimental Physics at the Univesity of Perugia. Perugia: Boncompagni Printing Office, 1893.

The author has deduced that the nodes determined with a single bridge do not coincide with the nodes determined with two bridges, and he has confirmed the fact that the internodes found are not equal, but increase towards the primary. These two results, he considers, are not to be ascribed to the manner of vibration of the primary.

Setting out from a formula of Cohn and Heerwegen, and from one previously established by himself (both deduced from the theory of Maxwell), the author has formed a theory for determining, *a priori*, the wave lengths of all possible systems of stationary waves in a Lecher's arrangement.

The agreement between the wave length calculated and that found by experiment is approximately perfect.

THE DEVELOPMENT AND TRANSMISSION OF POWER FROM CENTRAL STATIONS.*

By Prof. W. CAWTHORNE UNWIN, F.R.S.

III.

Transmission of Power by Wire-rope Cable.

The amount of work transmitted by a cable is proportional to the product of the effective tension in the cable and its speed. To transmit power to great distances by manageable cables the strongest material must be used for the cables, and they must be run at the highest practicable speed. The cables were at first of iron, now they are generally of steel. The largest cables which it appears to be practicable to use are about 1 inch in diameter. In order that the bending stress may not be excessive, the pulleys are of large diameter, 12 feet to 15 feet usually. For the throat of the pulley, on which the rope runs, gutta-percha, soft wood, and leather have been used. At present the bottom of the pulley groove is usually formed of strips of waste leather forced into a dovetailed groove. The greatest speed of rope practicable to adopt is that at which the centrifugal tension of the pulley rims becomes dangerous; 100 feet per second has been adopted as the greatest practicable speed. The pulleys are placed at maximum distances of 300 to 500 feet apart. The weight of the rope then ensures sufficient adhesion to prevent slipping when the ropes are tightened, so that the deflection or sag is not inconvenient. With these limitations, a 1 inch rope will transmit about 330 horse-power. The largest telodynamic transmissions have been constructed by Messrs. Rieter Bros., of Winterthur.

General Description of the System of Transmission by Wire-rope Cable.—The cables used are stranded ropes having 6 to 12 wires in each strand, and 6 to 10 strands in each rope. The strands are twisted on a hemp core, and usually there is a hemp core to each strand. The hemp makes the rope flexible. At first, Swedish charcoal iron was used; now, the ropes are more commonly of steel. They are protected from oxidation by a coating of boiled oil. It is necessary to keep a spare rope in reserve, in case of accident.

The ratio of the tensions in the tight and slack sides is about two to one. In passing round the pulleys the rope is bent, and the bending stress is added to the longitudinal stress. In order that the bending stress may not be excessive, large pulleys must be used. Their diameter is so chosen that the bending stress and longitudinal stress are about equal. As the tension in the slack side is less than that in the tight side, supporting pulleys for the slack side may be smaller than the driving pulleys.

Spans of 300 feet to 500 feet have been commonly adopted.

In order to give the wire-rope a greater frictional hold on the pulleys, and also to increase its durability, the pulleys have wide V grooves, bottomed with strips of leather pressed into a groove in the pulley edgeways. The pulleys are of cast-iron, or of cast-iron with wrought-iron arms. The leather packing in the groove requires renewal every three or four months, and involves a not inconsiderable cost of maintenance.

No other mode of transmission to moderate distances involves so little loss of work except electrical transmission.

At Schaffhausen a fall is made available, varying from 15·6 feet in low conditions of the river to 13·7 in high conditions. The turbine-house contains three turbines of 200, 260, and 300 horse-power. The turbines are axial flow pressure turbines with vertical shafts, driving a common horizontal shaft by bevil wheels.

Two hundred horse-power is taken directly from one of the turbines and transmitted to a factory on the hill above the turbine-house by a steel shaft 550 feet long. From the same shaft also about 22 horse-power is taken off by a subsidiary wire-rope transmission, which passes down the right bank and then across the river to a pulp factory. About 530 horse-power is dealt with by a main wire-rope transmission, which passes directly across the river to the left bank, and then along the river bank up the stream on the left shore.

Two cables cross the river in a single span of 385 feet to a pulley station in the river at the left bank, where the direction of the transmission is changed by bevil gearing, and thence the transmission passes up the left bank of the river.

The gross power in the horizontal driving shaft in the turbine-house is about 530 horse-power, or, allowing for friction, say 500 effective horse-power to be transmitted to the factories, or 250 horse-power for each rope. Either rope is capable of transmitting at any rate a large fraction of the whole power temporarily if the other rope is broken.

This power is delivered by the ropes at the change station on the left bank. At that station about 22 horse-power are taken off by prolonging the second shaft of the bevil-gearing, and a subsidiary rope transmission. The remaining 478 horse-power is transmitted along the left bank to the first intermediate pulley station, at a distance of 370 feet, by a pair of cables. Thence to the second intermediate station, distant 345 feet, by another pair of cables. At 455 feet further is another or second change station, at which the direction is again changed by gearing. Thence the ropes pass to two further intermediate stations.

From the second intermediate station an underground shaft carries about 27 horse-power to ten small workshops, and from the second change station, and the third and fourth intermediate stations, cables are carried back across the river to factories on the right bank. From the first shaft, at the second change station, about 110 horse-power are distributed, partly by a special rope gear, partly by vertical and underground shafting, to four factories, one of which is the large Mosersche Gebaude; and from the second shaft of this station a steel shaft transmits 200 horse-power to Scholler's wool factory. Between the turbine house and the second change station the cables consist of 80 wires, 0·042 inch diameter, in eight strands of ten wires each, with a hemp core; diameter of rope, 1·08 inch; speed of rope, 62 feet per second. Smaller ropes are used in other parts of the transmission.

It would appear that the rather complex arrangement of differential gear and double cables were intended originally to meet the case of having to drive by a single cable while the other cable was broken or under repair. It appears that, under present conditions, one cable would not be strong enough to transmit the whole power which is utilised; on the other hand, experience has shown that there is no necessity to duplicate the cable to avoid accidental stoppages. The total length of principal transmission is about 2,000 feet.

The charge for power in 1887 varied from £4 16s. to £6 per horse-power per annum.

The total cost of the works appears to have been reckoned at £29,360 originally, and this, by writing off, stood at £24,664 in 1887.

As to the working of the system it appears that experience has proved that there is a greater loss of power in transmission in wet and frosty weather than was originally expected. When the maximum power is being used, there are oscillations of the ropes which drive the machines at irregular speed. The spinning factory suffered most from this and ceased to take power. This has led to the construction of a new power station and the adoption in the new works of electrical instead of wire-rope transmission.

It is not thought that electric transmission will compete seriously with rope transmission for short distances, such as that at Schaffhausen; on the other hand, for long distances, it is admitted that electric transmission has the advantage.

At Tortona in Italy, in spite of the disadvantages of gearing, and the smallness of the power transmitted (7 or 8 horse-power), the loss

* Abstract of Howard Lectures delivered before the Society of Arts.

in normal conditions of working is only 6 per cent.; and the substitution of water-power and rope transmission for steam, effected an economy of 60 per cent.

At Fribourg in Switzerland, the turbines are Girard turbines, running at 74½ revolutions per minute. The turbine for transmission drives a horizontal shaft at 81 revolutions per minute by bevil wheels. This carries a 15 feet pulley with single groove driving the cable, by which power is transmitted to the plain of Perolles. The principal rope transmission consists of five equal spans of 500 feet each. The total distance to the saw-mill, at which power is first taken, is 2,500 feet, and the difference of elevation is 268 feet. The rope pulleys are all 15 feet in diameter, and the rope is 1·08 in diameter. The rope consists of 90 wires ·072 inch diameter in 10 strands of 9 wires with hemp cores. The speed of the rope is 62 feet per second. At the sawmill a subsidiary transmission works a railway for carrying timber and using 50 horse-power. This has a rope ⅝ths of an inch in diameter. From the shafting of the sawmill another subsidiary rope transmission takes 120 horse-power to railway carriage works, at a distance of 930 feet. From the carriage works there is a further transmission of 60 horse-power by a ½-inch rope a distance of 1,600 feet, and thence by ropes, ⅜ths inch in diameter, to a foundry and chemical factory. The power is sold at the rate of 200 frs., or £8 per horse-power per annum.

The most recent and one of the largest telo-dynamic transmissions has been erected at Gokak, in the southern Mahratta country in India. This installation has been carried out by Messrs. Escher Wyss, of Zurich.

The river falling over a high cliff has motive-power enough for many industries. At present three turbines of 250 horse-power each (750 horse-power altogether) have been erected to drive a cotton-mill of 20,000 spindles. The water taken at 2,300 feet above the fall is led by a channel to the edge of the cliff, and thence in a 32-inch wrought-iron pipe. The pipe descends about 110 feet vertically on the face of the cliff, and then is inclined at about 30° to the horizontal. In the turbine house the three turbines are supplied by three 24-inch branch pipes. The total fall acting at the turbines is 180½ feet. The turbine wheels are 67 inches in diameter, and they run at 155 revolutions per minute.

The turbines are action or impulse turbines with partial admission; and they have horizontal axes, each turbine axis carrying a wire-rope driving pulley. There is a sluice valve, worked by hand, and a throttle, or disc valve, controlled by a governor, to each turbine. The governor is a relay governor, in which a belt on speed cones drives differential gearing connected with the throttle valve. If the governor moves the belt to either side of its central position, the differential gear comes into operation, and opens or closes the throttle-valve.

The shafts of the turbines carry wire-rope pulleys 11½ feet in diameter. The rope speed is 93 feet per second; the ropes are 1 inch diameter. At the top of the cliff is a rope station, with carrier pulleys 198 and 220 feet above the turbine shafts. The pulley for the tight side of belt is 11½ feet diameter; that for the slack side is 8 feet in diameter. The distance from this station to the mill is 432 feet, and there is an intermediate carrier station for the slack side of the belt, which would otherwise foul the ground. There are, of course, three ropes, one to each turbine. The installation was set to work in October, 1887.

Advantages and Disadvantages of the Telo-dynamic System.—The telo-dynamic system is adapted for transmitting and distributing power to distances of a mile or more, which are large compared with the distances to which power is ordinarily transmitted by shafting and similar means. On the other hand, it cannot seriously compete with electrical transmission in cases where the distance to be covered is reckoned by many miles. With this limitation it may be noted that:—

1. It has the peculiar advantage that it transmits the mechanical energy developed by the prime mover directly without any intermediate transformation. In electrical distribution, a double transformation is necessary—a transformation into electrical energy by a dynamo, and re-transformation back into mechanical energy by an electric motor. This double transformation involves waste of power, and increase of capital expended.

2. The efficiency of transmission to such distances as those at Schaffhausen is undoubtedly very great; it is uncertain whether a similar amount of power could be distributed to an equal number of consumers electrically with as little waste of energy in the process.

3. The telo-dynamic transmissions which have been at work, some of them since 1864, have actually worked continuously, without serious stoppage, and have only failed to return an adequate profit where they were undertaken on a scale too large for the amount of industry requiring to be supplied with power in the locality.

4. Where, as at Bellegarde and Fribourg, the power station is 150 or more feet below the factories driven, the telo-dynamic system has an advantage over some systems, such as the hydraulic system, that there is no loss of efficiency due to difference of level.

On the other hand, it may be admitted that telo-dynamic transmissions, simple as they are mechanically, involve considerable cost. The pulley piers require to be lofty, and strongly built. The maximum length of span hitherto accomplished is 630 feet at Bellegarde. Experience has also shown that the cost of maintenance is considerable. The cables must be replaced annually, and experienced workmen are necessary to make the long splices in the ropes.

One distinct disadvantage of the telo-dynamic system is, that no means has been found of directly measuring, by numerous or continuous observations, the amount of power delivered to each consumer. So long as the power is distributed to very few consumers, it is possible to assess, with practical fairness, the charge to each, without such measurements of the power. But, in proportion as the consumers are more numerous, the defect of the system in this respect becomes more serious. A recording transmission dynamometer would, of course, obviate the difficulty, but the cost of such an appliance is considerable.

It is, in some cases at any rate, a defect of the cable system that the amount of power which it is practically possible to transmit by a single cable is limited. It is not possible by increasing the size of the cable to transmit an indefinitely large amount of power. The cables became too heavy to be manageable, and the pulleys too large in diameter. In the report of the experts advising the town of Geneva, in 1889, the limit for one cable was placed at 100 horse-power; Messrs. Rieter Bros. place it at 300 horse-power, and that amount has, in fact, been transmitted; no doubt the proper limit varies in different cases.

It is also an inherent characteristic of the cable system that the efficiency decreases rapidly when the distance increases beyond certain moderate limits. On the most favourable interpretation of the experiments the efficiency may be ·96 for 100 yards or ·93 for 500 yards, efficiencies remarkably high. But the efficiency falls to ·60 for 5,000 yards, an efficiency by no means remarkably good.

NEW PATENTS—1893.

18,386. "Improvements in electrical switches." E. W. LANCASTER. Dated October 2nd. (*Complete.*)

18,392. "Improvements in electric clocks and watches." W. W. G. WEBB. Dated October 2nd.

18,403. "Improved means of inter-communication by telephone." J. J. MANN. Dated October 2nd.

18,404. "Improved means of inter-communication by telephone." J. J. MANN. Dated October 2nd.

18,428. "Improvements in electric telegraphs, and mechanism used in connection therewith." G. DRAPER and A. FRASER. Dated October 2nd.

18,457. "Electrically lighted letters." H. HAWKSEY. Dated October 3rd.

18,475. "Electric signals for railways." A. M. THOMPSON. Dated October 3rd.

18,480. "Improvements in armatures for dynamo-electric machines and electric motors." M. RAHNER. Dated October 3rd. (*Complete.*)

18,482. "Means for determining the presence and intensity of atmospheric electricity." J. OPPERMAN. Dated October 3rd. (*Complete.*)

18,524. "Improvements in indicators chiefly designed for use at telephone stations, also used for advertising purposes." I. R. BURNS and W. F. BURNS. Dated October 3rd. (*Complete.*)

18,530. "Improvements in the arrangement and connection of conductors for electric railways." SIEMENS BROS. & CO., LIMITED, and G. H. THORNTON. Dated October 3rd.

18,586. "An improved regulator for arc lamps." L. ZAUSMER. Dated October 4th.

18,596. "Improvements in the means or mode of protecting insulators as employed for electrical purposes or appliances." W. MARTIN. Dated October 4th.

18,602. "Improvements in telephone switchboards." C. D. ABEL. (Communicated by the Société Générale des Téléphones, Reseaux Telephoniques et Constructions Electriques, France.) Dated October 4th.

18,609. "Improved telephone attachment." J. G. FOSTER. Dated October 4th.

18,610. "Improved electrical heating apparatus." P. R. J. WILLIS. (Communicated by C. E. Roehl, S. Z. Mitchell, and E. P. Wetmore, United States.) Dated October 4th.

18,620. "Improvements in pocket batteries." E. MAYER. Dated October 5th.

18,626. "Improvements in electrical conductors." J. B. KING and T. E. BICKLE. Dated October 5th.

18,661. "Improvements in electric telegraphs for steering, engine room, and other signalling purposes." F. G. P. PRESTON. Dated October 5th.

18,674. "Improvements in electrical receiving instruments and relays." THE PHONOPORE COMPANY, LIMITED, and C. E. SPAGNOLETTI. Dated October 5th.

18,690. "Improvements in conduits for electric conductors." C. G. PICKING. Dated October 5th.

18,734. "Improvements in electric meters." H. P. OLSEN. Dated October 6th.

18,805. "Improvements in electric measuring instruments." B. DAVIES. Dated October 7th.

18,841. "An improvement in incandescent electric lamps and sockets." THE EDISON AND SWAN UNITED ELECTRIC LIGHT COMPANY, LIMITED, and J. A. FLEMING. Dated October 7th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1892.

2,652. "Improved regulator for voltaic arc lamps." F. KLOSTERMANN. Dated February 11th. The carbon carriers, suitably guided vertically, are both suspended to a cord which is wound on a drum, the axis of which carries a brake and a ratchet wheel. One end of

this cord is guided by a grooved pulley placed on the armature of the electro-magnet traversed by the main current, and carries the negative carbon-carrier; the other end carries the positive carbon-carrier. By a novel mechanical arrangement and the combination of the derived current, the positive carbon pencil is lowered and the negative one raised in proportion as they are consumed, so as to maintain the luminous point in a constant position. 3 claims.

3,112. "Improvements in electric meters." S. Z. de Ferranti. Dated February 17th. Consists chiefly in making all the parts in contact with the mercury, of a metal or metals which are not attacked, such as nickel, aluminium, platinum, iron, steel, iridium, nickel steel, manganese steel or iron, and iron or steel containing spiegel. 14 claims.

3,113A. "Improved means for conveying currents of high tension, and in appliances used for this purpose." S. Z. de Ferranti. Dated February 17th. Relates chiefly to a special insulator, which consists of a porcelain or glass rod held in a clamp at the bottom to fix upon the poles, and having a cap fixed on its top end, which holds the wire to be insulated, or the wire may be passed through a hole or slot in the end of the insulating rod instead of being held by a cap fixed on the rod. 21 claims.

3,240. "Improvements in materials or compounds to be used in the manufacture of moulded articles, such as door handles, insulators for electrical purposes, boxes, toys, and other articles of the like kind." J. Lang. Dated February 19th. Relates to the manufacture of moulded articles formed of a novel compound, the composition of which may be varied more or less, but consisting principally of what is known as infusoria, combined with shale, asbestos, whiting, resinous gums, oils, mastic and colouring matters, which when thoroughly mixed and incorporated together in suitable proportions form a plastic mass, which when moulded into the desired form may be hardened under pressure, and which can be vulcanised in a vulcaniser in the ordinary well known way, or hardened by a much cheaper process by baking when in compressed moulds. 1 claim.

5,186. "Improvements in electric arc lamps." L. Lenczewski. Dated March 16th. Consists in the adaptation to an arc lamp, for the lighting and for the first regulation of the same, of a differential solenoid composed of two superposed bobbins wound respectively with thick and with fine wire (or of a single bobbin with a double winding of thick and fine wire). The bobbin of thick wire is placed in the main circuit of the lamp, whilst the bobbin of fine wire is placed in a shunt to said circuit. The two bobbins act in opposite senses upon the same soft iron core. 3 claims.

5,404. "Improvements in magnetic compasses." J. H. Steward. Dated March 18th. Relates more particularly to magnetic compasses for military and other purposes, where a pocket or portable compass will be useful at night for marching on a definite position or for travellers and surveyors. 6 claims.

5,655. "An improved electric safety lamp." J. P. Rees. Dated March 22nd. Is constructed so that, should the glass globe or bulb be broken, the electric circuit will at once be automatically interrupted and the lamp thus extinguished. 1 claim.

6,088. "Improvements in the manufacture of filaments for incandescent electric lamps." M. Boehm. Dated March 29th. Consists in employing as a basis for the construction of the filament, an extremely fine wire made of a suitably soft but tenacious metal or alloy, or mixture of metals. 4 claims.

6,465. "Improvements in electrical secondary or storage batteries." G. E. Heyl. Dated April 4th. Relates to certain improvements in the construction of grids for secondary or storage batteries, the objects being to provide a greater contact surface between the framework and the substance or composition with which said framework is filled, and also to provide for the expansion of said substance or composition. 2 claims.

6,720. "Improvements in dynamo-electric machines." J. A. Kingdon. Dated April 7th. The inventor employs for the field magnets the type of electro-magnet suggested by Holmes in 1868, and consisting of a single exciting coil of conducting wire surrounding an iron core, from the two ends of which spring a number of polar projections. 5 claims.

6,888. "An improved conduit system for electric conductors." W. L. Spence. Dated April 11th. Consists essentially of the following parts; (*a*) an outer casing or trough of brickwork, cement-concrete, cast as galvanised iron or other suitable material. This trough is drained through traps in the well known manner; (*b*) a series of separate insulators of any suitable design, some forms of which are shown in the drawings; these insulators serve to support in place with an air insulation; (*c*) a series of continuous closed non-conducting pipes made of glazed earthenware or its equivalent. 3 claims.

6,911. "Improvements in change-over mechanism for electric arc lamps." W. J. Davy. Dated April 11th. Consists of two carbon holders, together with suitable mechanism for providing that when the first pair of carbons are burnt out, the holders are lifted back into their striking position, and by an automatic arrangement the two fresh or succeeding carbons are shot into the receivers on the said carbon holders. The said receivers are made or arranged so as automatically to receive the carbons and to hold them in place. 6 claims.

6,989. "Improvements relating to conduits applicable for combined use as casings for electrical conductors and for gas supply, or for either use separately." J. A. McMullen. Dated April 12th. The conduits intended for the combined purposes of gas and electric lighting, or for either purpose separately, consist of pipes or tubes of metal or other suitable material. These pipes or tubes are fitted up in the usual well-known manner in which gas piping is fixed, but lengths of cord or wire, or other suitable means, are left in their interior, by which electrical conductors can at any time be pulled through them. In order that this may be done without damage to the conductors, the angles in the piping consist of specially constructed gas-tight angle pieces having grooved rollers pivoted within them, over which the conductors may pass without friction. Where the system known as the "one-wire system" is used, the electric conductor consists of one properly insulated flexible conductor only, the metal pipe being used as the return conductor. When the "two-wire" system is used, it is preferred to employ conductors made up in a concentric form, the centre being composed of a strand of numerous fine wires coated to a sufficient thickness with insulating material, around which the other conductor, composed of a similar number of fine wires, is stranded, the whole being coated with a sufficient outer insulating covering. 3 claims.

7,037. "An improvement in electric arc lamps." R. Belfield. Dated April 12th. The inventor connects, by suitable gearing to the carbon or its motor, an escapement wheel arranged to act on a pair of anchors, to which is attached a small pendulum. When the carbon is moved by the action of the solenoid, the escapement wheel is caused to turn through part of a revolution, causing the pendulum to swing to and fro. As the rate at which it swings is determined in great measure by its length, it does not allow such sudden movements of the carbon as have any objectionable effect on the light. 1 claim.

21,830. "Improvements in apparatus connected with flexible electrical conductors, and electrical connections therefor, applicable for use in mines." C. W. Atkinson and The Electrical Coal Cutting Contract Corporation, Ltd. Dated November 29th. Consists, firstly, in a winding drum carried on carrying wheels, the said drum being adapted to wind the electric cable upon itself, and driven by the carrying wheels through friction gearing, a collecting device being provided to complete the electrical continuity of circuit from the cable on the rotating drum, to the fixed length of cable attached to the motor of the machine to be driven; and, secondly, in an improved and special construction of junction box and contact breaker, with a lock-up fastening, so arranged that the breaking or making of the contact can be effected in such a way that the production of violent sparking during the operation is not dangerous or does no damage. 4 claims.

22,308. "Improvements in incandescent electric lamps." E. W. Applegate. Dated December 6th. The inventor employs a plug, through which are passed the leading-in wires, which plug, being of any desired shape or form to suit the various kinds of lamps; the plug may be of any suitable material, and it is cemented or held by pressure and cement to the glass part of the bulb in any suitable manner, or by any suitable means.

22,375. "Improvements in the method of welding or working metals electrically." W. P. Thompson. (A communication by C. L. Coffin, of Detroit.) Dated December 6th. Claim:—The described method of heating metals electrically, consisting in heating the material on one side by contact with a conductor in electrical connection with one terminal of a generator, and heating the material on the other side by a voltaic arc.

22,987. "Improvements in secondary battery plates or elements and in the process of preparing same." P. M. Justice. (A communication from abroad by W. W. Griscom, of America.) Dated December 14th. Consists in submitting the plate to the action of an alkaline solution, in which it is boiled until the surface of the plate becomes honey-combed to a depth, say of $\frac{1}{100}$ths of an inch, more or less, and within these honey-combings, and on the surface, the active material, or material to become active, is deposited, either from the solution itself, or otherwise. 6 claims.

23,086. "Improved arrangement for communicating by telephone between several stations." R. D. Smillie. Dated December 15th. The object of this invention is to obtain communication between one station and any one of a number of other stations direct without the necessity of a central station worked by a third party, and to have the entire system of stations excited by one or more batteries common to all the installation or parts thereof, thus avoiding the necessity of a local battery at each station for calling or speaking circuits, or both. This is attained by running battery wires from the positive and negative poles of the main battery or batteries, and branching therefrom to each station. 1 claim.

23,232. "Improvements in and relating to secondary or storage batteries." J. Y. Johnson. (Communicated from abroad by A. M. Michel, of Paris.) Dated December 16th. Claims:—1. The process of making active material for secondary or storage batteries by forming an alloy of lead and other metal, such as zinc, disintegrating or reducing the alloy, eliminating the metal alloyed with the lead, and leaving the latter in a porous, distended condition, and compressing into the desired form. 2. In a lead zinc secondary, or storage battery, a negative element consisting of the combination with a frame, core or other suitable support, of an amalgam rich in mercury, securely held therein. 3. The manufacture of electrodes for lead zinc secondary, or storage batteries, by spreading over or introducing into the interstices, or spaces, between frames, divisions, wire gauze, rods or supports of any suitable form, amalgams rich in mercury, that is to say, composed of about equal proportions of mercury and of the other metal employed.

23,421. "Improvements in sockets for incandescent electric lamps." B. J. B. Mills. (A communication from J. Hutchinson, of New York.) Dated December 20th. According to this improvement insulating socket bodies are formed of proper shape, and terminals and also a metal shell are clamped thereto, instead of connecting said parts to the body by screw connections, or by moulding the insulating socket body around them, as is commonly done. 4 claims.